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ABSTRACT

Introductory Physical and Earth Science 8AB, a required course in the Los Angeles Unified School District, covers skills and concepts related to matter, energy, space science, weather, and oceanography with particular emphasis on the investigative approach. This instructional outline contains teacher guidelines and course content information. Major sections include: (1) summary of representative objectives; (2) teacher responsibilities; (3) schedule of class activities; (4) guidelines for assignment of homework; (5) how to use this outline; (6) time schedule and sequence of units; (7) required skills and concepts (containing the objectives, content outlines, and continuum skills for seven units of study); (8) lesson planning (providing seven sample lessons); (9) teaching strategies; (10) major categories of thinking and some verbs for use in stating cognitive outcomes; (11) evaluation procedures; and (12) tips for parents. Appendices consist of a list of resources and the secondary science continuum for the Los Angeles Unified School District. (ML)

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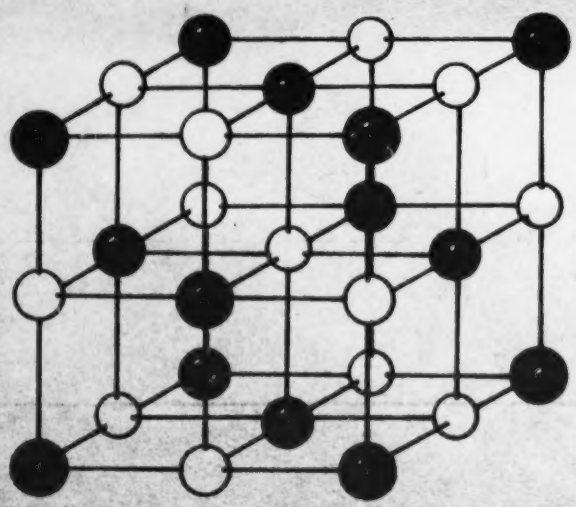

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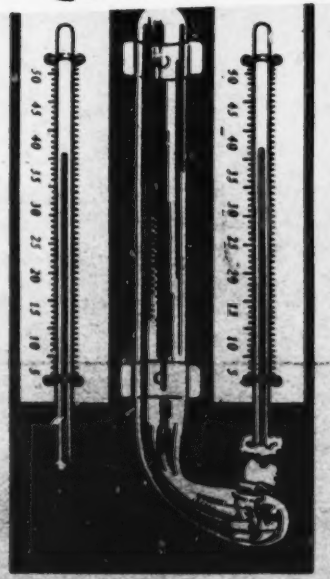

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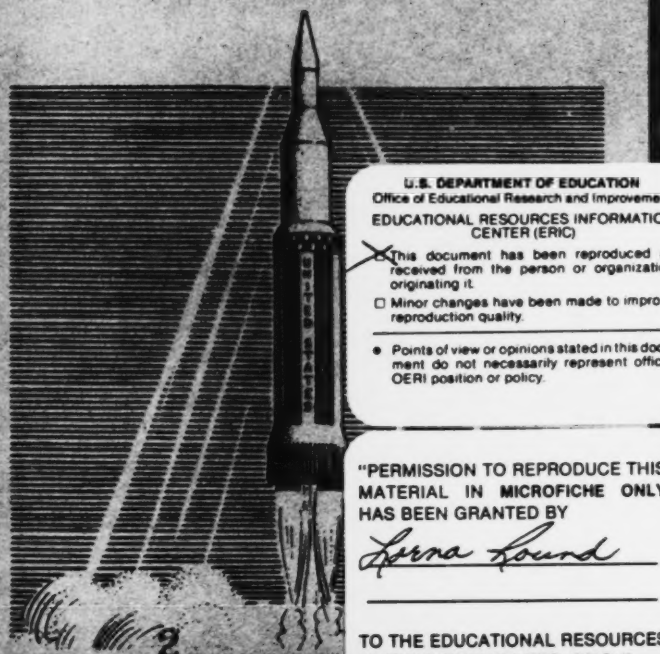

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LOS ANGELES UNIFIED SCHOOL DISTRICT
Office of Secondary Instruction
Publication No. SC-864 1984

INTRODUCTORY PHYSICAL AND EARTH SCIENCE 8AB

AN INSTRUCTIONAL COURSE OUTLINE

LOS ANGELES UNIFIED SCHOOL DISTRICT
Office of Instruction
Publication No. SC-864 1984

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FOREWORD

Science is the discipline through which people acquire and organize knowledge to explain natural phenomena and to increase their usefulness to humankind. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge that is comprised of interconnected sets of principles, laws, and theories. These explain the known universe and our relationship to it. Students investigate phenomena systematically and acquire and refine information. Outcomes include an increased understanding of how human beings use scientific information; of how discoveries are essential for analyzing and comprehending the environment; and of how solutions are sought to resolve problems of daily living.

Introductory Physical and Earth Science 8AB, a required junior high school subject which follows Biological Science 7, emphasizes a basic knowledge of science as fundamental to good citizenship and effective participation in today's society. Introductory Physical and Earth Science 8AB is designed to help students gain a basic knowledge of science and to develop appropriate science skills, learning processes, and attitudes.

The course covers an introduction to physical science, matter, energy, space science, earth science, weather, and oceanography, with particular emphasis on the investigative approach. This outline also contains an introductory section on skills and concepts which has important applications in instruction throughout the course. Sample lessons for each content area are included.

ACKNOWLEDGMENTS

Many persons contributed to the development of this instructional outline. Gratitude is expressed to those individuals who reviewed the content, suggested changes in the course descriptions and objectives, and recommended unit titles and concepts.

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SUMMARY OF REPRESENTATIVE OBJECTIVES

UNIT TITLE	OBJECTIVES
SKILLS AND CONCEPTS REQUIRED AND DEVELOPED IN INTRODUCTORY PHYSICAL AND EARTH SCIENCE 8AB	- Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures. - Develop ability to generate data by observing, recalling, recognizing, identifying, and measuring. - Prepare a laboratory report. - Gather information from the library and other appropriate sources.
Unit One INTRODUCTION TO PHYSICAL SCIENCE	- Use the metric system effectively. - Assemble and use laboratory apparatus in a safe manner. - List the steps of the scientific method. - Participate in scientific inquiry at the appropriate level.
Unit Two MATTER	- Recognize that elements are composed of atoms. - Recognize that matter exists as solids, liquids, and gases. - Demonstrate that matter undergoes physical and chemical changes. - Describe the interaction and reorganization of units of matter.

UNIT TITLE	OBJECTIVES
Unit Three	
ENERGY	- Demonstrate the interactions between matter and energy. - Identify examples of pótential and kinetic energy. - Describe at least four types of energy. - Understand the definitions and interrelationships of force, work, and energy.
Unit Four	
SPACE SCIENCE	- Demonstrate knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe. - Demonstrate knowledge of the effects of the moon and sun on ocean tides. - List the planets in the solar system. - Describe the tools which astronomers use to study the universe.
Unit Five	
EARTH SCIENCE	- Describe the earth's layers. - Describe the composition of the earth. - Identify forces that are constantly changing the earth's surface. - Explain the theory of plate tectonics.

UNIT TITLE	OBJECTIVES
Unit Six	
WEATHER	- Identify major factors that cause weather changes and patterns. - Measure temperature in degrees Celsius and Fahrenheit. - Identify the earth's major climates.
Unit Seven	
OCEANOGRAPHY	- Explain the causes of ocean waves. - Discuss current research in oceanography. - Explain how living organisms are affected by the oceans. - Identify the main areas of the ocean floor.

TEACHER RESPONSIBILITIES

The teacher is responsible for creating, maintaining, and fostering a classroom environment and climate that encourages instructional excellence and achievement. To establish and maintain such an environment, the teacher is responsible for:

1. Providing students and parents with a clear statement of instructional objectives, overall goals, and standards of expected progress and achievement.

2. Providing instruction which incorporates a diagnostic-prescriptive program for learning all required skills and concepts.

3. Following the timeline as closely as possible, preparing instructional activities for the entire class period, and assisting students in striving for mastery of content and process skills.

4. Having evidence in the classroom of lesson planning to meet the educational needs of the students and the goals of the instructional program.

5. Providing regular instruction and practice in preparing students to perform successfully on tests and other measures of achievement.

6. Maintaining well-defined and consistent classroom standards for academic achievement, citizenship, and work habits.

7. Providing regularly assigned homework designed to reinforce classroom instruction.

8. Providing students and parents with an explanation of the standards used for assigning marks.

9. Providing prompt feedback to students on the results of quizzes, homework, and other class assignments.

10. Recording in the rollbook a minimum of one grade per week for each student.

11. Recognizing individual student progress and exceptional achievements; displaying examples of student accomplishments and products in the classroom.

12. Keeping parents regularly informed of the educational progress and achievement of the student.

13. Informing parents of outstanding progress and accomplishment.

14. Notifying parents of any signs of significant academic decline in student effort or achievement.

15. Providing parents with suggestions on how to help the student study and complete homework assignments.

16. Inviting administrators, department chairpersons, and teacher colleagues to visit the classroom and participate in a sharing of effective and innovative lessons.

THE AGENDA

An agenda, or schedule of class activities, prominently displayed in the classroom, gives immediate directions to the students and prepares them for the day's classwork. The agenda should include an objective, a dispatch activity, scheduled class activities, and homework assignment. The agenda may be written on the chalkboard. Some teachers, particularly teachers who travel from classroom to classroom, prefer to use chart paper that can be easily taped or pinned to a board and quickly removed to be used in a new location. A good way to evaluate an agenda is to ask the question "If a student were absent, could he or she read the agenda and know what happened in the classroom today?"

The dispatch activity is an essential part of the agenda. It should be a short, written, timed exercise that students start as soon as the period begins. Students should be able to complete the dispatch without teacher assistance. The dispatch is used to:

- review and reinforce concepts and ideas previously studied
- start students working immediately upon arrival in class
- preview or introduce new work
- establish a routine
- allow the teacher an opportunity to take care of attendance responsibilities

Below is a sample agenda as it should be written on the board.

AGENDA

Teacher's Name
Physical and Earth Science 8AB, Period 1
September 1984

Objective: To observe and record current weather conditions.

Dispatch: Based on observations you made on the way to school, write a report on today's weather.

Class work:	Measure air temperature with a thermometer, air pressure with a barometer, and relative humidity with a psychrometer.
Independent work:	Record observed data on a daily chart. Prepare charts to record each weather condition for the next week.
Homework:	Bring a weather report from the daily newspaper. Write a summary of the report, comparing it to conditions observed in class. Write a paragraph on how each of the three weather instruments works.
Summary:	Review correct use of thermometer, barometer, and psychrometer.

GUIDELINES FOR ASSIGNMENT OF HOMEWORK

These guidelines should be considered when planning homework assignments:

1. Homework is an important resource for teachers in helping students to learn.
2. Homework may be scheduled, when appropriate, over an extended period of time, which may include weekends.
3. Homework assignments should be reasonable in length, content, and required resources.
4. Homework should be assigned to reinforce, extend, and enrich learning.
5. Homework assignments should be related to course objectives.
6. Homework assignments and due dates should be thoroughly explained by the teacher and understood by the student.
7. Once homework has been assigned, it becomes the responsibility of the student to learn the content, process, and due date and to complete the assignment as required.
8. Completed homework assignments should be acknowledged and/or evaluated by the teacher and reviewed with students.

Parents and guardians should be informed of homework schedules, including dates given and time allowance. They should also understand the level of independent work expected of the student and the parental help and involvement required.

HOW TO USE THIS OUTLINE

This outline was designed to assist the teacher. It includes a summary of representative objectives, a time schedule, and a sequence for each unit. The introductory section on skills and concepts is not designed to be taught separately but is to be included throughout the course as each unit is studied. The skills and concepts in the introductory section are those which are to be developed as needed for maximum relevance to the student laboratory activities. Included are safe laboratory practices, use and care of living organisms, proper care of laboratory equipment, use of the scientific method, preparing graphs, and necessary library and research skills.

The seven units are divided into suggested content areas. The content of each area is correlated with the skills continuum which begins on page 117, with the skills to be developed in this course, and with sample teacher-directed lessons. The sample lessons for the seven units are developed in accordance with the Quality Skills Building (QSB) model. This model has been selected because the students will find the results of the lessons to be more effective and enjoyable.

By developing a lesson in this format, the teacher will be able to clarify outcomes, values to students, and strategy. Planning and preparation of worksheets and study guides for students are encouraged. The guides and worksheets should be designed for use in both the regular and alternative lessons and for high- or low-ability students.

In the teaching strategies section is presented a variety of teaching methodologies to provide for different learning modalities.

In the evaluation section, the teacher will find suggestions and descriptions of different methods of testing. By using the QSB model, the teacher can clarify objectives in order to expedite testing.

Tips for parents are designed to assist teachers in obtaining parental support. Copies of these tips may be distributed to students to help stimulate parent involvement.

The appendices include titles of District publications and the skills continuum. The continuum should be used to identify representative goals and objectives for students in the strands of attitudes, skills, thinking processes, and knowlege. The continuum may also be used to teach and reinforce these goals and objectives.

TIME SCHEDULE AND SEQUENCE OF UNITS

UNIT	TOPICS	WEEKS
ONE	INTRODUCTION TO PHYSICAL SCIENCE	5
TWO	MATTER	7
THREE	ENERGY	6
FOUR	SPACE SCIENCE	7
FIVE	EARTH SCIENCE	7
SIX	WEATHER	4
SEVEN	OCEANOGRAPHY	2

SKILLS AND CONCEPTS REQUIRED AND DEVELOPED IN INTRODUCTORY PHYSICAL AND EARTH SCIENCE 8AB

Representative Objectives for This Section

- Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.
- Develop ability to generate data by observing, recalling, recognizing, identifying, and measuring.
- Prepare a laboratory report.
- Gather information from the library and other appropriate sources.

Content

I. Safe, careful, and responsible laboratory practices are essential for scientific instruction.

A. General laboratory safety

1. Order and cleanliness are essential for maintaining safe laboratory conditions.

2. Students should not be allowed to perform any experiment without a teacher's direct supervision.

3. Safety instructions should be thoroughly reviewed before attempting any experiment.

4. Constant supervision of student activities is essential in the laboratory.

Continuum Skills

3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.

3.1.3 Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.

Content	Continuum Skills
5. Every laboratory should have two unobstructed exit doors.	
6. Fire extinguishers and fire blankets should be operable and visible.	
7. Bunsen burners pose a safety hazard to long hair and loose clothing.	
8. Safety goggles should be worn when any experiment calls for heating, pouring, or mixing chemicals or any other activity that may be harmful to the eyes.	
9. Chemical substances should never be tasted nor inhaled.	
10. Rubber gloves should be used whenever poisonous substances are handled.	
11. Care should be taken when handling hot objects. Tongs or gloves should be used.	
12. Teachers should make certain that bunsen burners or hot plates are turned off after each class.	
13. Master cutoff valves are advisable in laboratories with gas or water.	
14. Immature behavior or horseplay should not be permitted in the laboratory.	
15. Teacher should make frequent safety inspections of the laboratory.	
B. Use and care of laboratory animals and plants.	3.2.0 Demonstrates proper techniques for handling and caring for living organisms.
1. Laboratory animals should be cared for properly.	3.2.1 Handles plants and animals carefully, following suggested procedures.

Content	Continuum Skills
2. Aquaria and animal cages should be cleaned regularly.	1.3.1 Accepts responsibility for the care of the living organisms in natural and artificial environments.
3. Animals should be fed and watered when necessary.	3.2.2 Provides an environment for plant and animal life that is conducive to the support of normal life functions.
4. Holiday, weekend, or vacation care of plants and animals should be planned in advance.	
5. Animal or plant specimen bottles should never be opened.	
6. Animal specimens preserved in formaldehyde or formalin should be washed thoroughly before being handled.	
7. Petri dishes containing bacteria or molds should be taped securely and disposed of properly.	
C. Proper care of laboratory equipment.	
1. Microscopes are expensive and delicate instruments and should be handled with care.	3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.
	3.1.2 Demonstrates growth in the ability to manipulate more complex science materials and equipment.
a. Students should be instructed always to carry a microscope upright with two hands, one hand holding the arm and one hand supporting the base.	3.1.3 Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.
b. Microscopes should be stored with the low-power objectives in position.	

Content	Continuum Skills
c. Students should be instructed not to allow direct sunlight to reflect from the mirror into their eyes.	
d. Microscopes should be stored in a cabinet or covered with a plastic cover to protect them from dust.	
e. Microscope lenses should be cleaned only with lens paper.	
f. Microscope oculars should never be removed.	
g. Care should be taken when switching from low to high power.	
2. Beam balances are very delicate instruments.	
a. Beam balances should never be "over-loaded" (210 grams is the maximum capacity).	3.7.1 Counts, uses numbers, and balances objects on an equal-arm balance scale.
b. Beam balance pans should be cleaned properly and regularly.	3.7.3 Uses a balance to determine the mass of objects.
c. Beam balances should be carried with both hands supporting the base.	
d. Beam balances should be stored in cabinets.	
3. Glassware (flasks, beakers, etc.) must be used carefully to avoid breakage, spilled chemicals, and possible injury to students.	3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.
	3.1.2 Demonstrates growth in the ability to manipulate more complex science materials and equipment.

Content	Continuum Skills
4. All laboratory equipment should be used only with teacher supervision.	
5. All laboratory equipment should be stored and locked in cabinets.	
II. Accurate qualitative and quantitative data are important sources of scientific information.	
A. The scientific method should be used in writing laboratory reports. (See Unit One.)	2.1.0 Develops ability to generate data by observing, recalling, recognizing, identifying, and measuring.
1. Laboratory reports should include:	2.2.0 Develops ability to organize data by comparing, classifying, relating, and ordering.
a. Title of experiment	3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.
b. Equipment or material used	2.3.0 Develops ability to apply and evaluate data and generate theories by hypothesizing, predicting, inferring, generalizing, theorizing, explaining, justifying, judging, and interpreting.
c. Description of the problem	2.3.2 Gathers own data to form own point of view, satisfying any former contradictions.
d. List of procedures	2.4.0 Participates in scientific inquiry at the appropriate level.
e. Observations	2.4.2 Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data.
f. Results obtained from observations	3.5.2 Tabulates information and uses tables.
g. Conclusions	
2. Recording and reporting data are very essential to scientific inquiry.	
B. Preparing a graph is a very important method of displaying data collected in scientific experiments. Students should	

Content	Continuum Skills
be instructed in the importance of recording on graphs the results of experiments and shown how to prepare graphs.	3.5.3 Interprets graphs and displays data graphically.
III. Library and research skills are necessary for investigating topics of scientific interest.	
A. Students should be encouraged to use science texts and encyclopedias.	3.4.0 Gathers needed information, which has been generated by others, from a variety of sources appropriate to his/her ability level.
B. Students should be instructed on how to use the Reader's Guide to Periodicals.	3.4.2 Gathers information from science textbooks, reference materials, films, and television.
C. Students should be acquainted with the Dewey Decimal System, especially where scientific books can be located.	3.4.3 Finds sources of information needed to solve a problem related to a specific topic.
D. Students should be encouraged to use recent scientific journals, periodicals, and newspapers.	

UNIT ONE: INTRODUCTION TO PHYSICAL SCIENCE

FIVE WEEKS

Representative Objectives for This Unit

- Use the metric system effectively.
- Assemble and use laboratory apparatus in a safe manner.
- List the steps of the scientific method.
- Participate in scientific inquiry at the appropriate level.

Content	Continuum Skills
I. What is science? Science is a way of answering questions and solving problems.	
A. Scientific information comes from many different sources.	(Skills - III): Library and research skills are necessary for investigating topics of scientific interest.
1. Reference to authority: Scientific laws, theories, and facts gathered and recorded in the past contribute to a body of scientific knowledge.	3.4.0 Gathers needed information, which has been generated by others, from a variety of sources appropriate to his/her ability level.
	3.4.2 Gathers information from science textbooks, reference materials, films, and television.
2. Trial and error: Trial and error methods often result in the generation of important scientific ideas for controlled experiments and research.	4.1.1 Distinguishes between trial and error and controlled investigations.
	4.2.1 Identifies simple cause-effect relationships.
3. Experimentation: Experimentation is used to collect data and test hypotheses.	4.2.2 Uses a cause-effect relationship to make a prediction.

Content	Continuum Skills
4. Scientific Methods: Scientific methods involve the use of a series of steps which suggest ways of collecting data and testing hypotheses.	(Skills - II): Accurate qualitative and quantitative data are important sources of scientific information.
B. Science is a part of everyday living.	4.1.2 Matches names of various processes and products of scientific inquiry with examples.
1. Science explains many common observable occurrences.	4.1.3 Evaluates procedures in the inquiry process that have been omitted or inadequately performed.
2. Curiosity about common occurrences leads to scientific investigation.	(Skills - II A.): The scientific method should be used in writing laboratory reports.
3. Observable facts may be distinguished from opinions.	4.3.0 Demonstrates knowledge of relationships between science and society.
4. Scientific achievements improve our daily lives.	1.7.0 Has a critical, questioning attitude toward inferences, hypotheses, and theories.
C. Science can be divided into many different fields of study.	1.6.2 Forms opinions only after seeking a variety of data and ideas.
1. In biological sciences, such as Biology, Zoology, Botany, Microbiology, Genetics, and Ecology, living things are studied.	
2. In physical sciences, such as Physics, Chemistry, Astronomy, Geology, and Meteorology, non-living things are studied.	
D. Science is an advancing frontier.	
1. Scientific explorations open new areas for investigation.	4.3.0 Demonstrates knowledge of relationships between science and society.
2. Future advancements in science and technology are interdependent.	4.6.0 Demonstrates knowledge of the relationships of science to other areas of human endeavor.

Content	Continuum Skills
a. Scientific knowledge has made possible a great variety of technological applications.	
b. Instruments, such as telescopes, microscopes, and computers, have greatly broadened the scope of scientific investigation.	
II. Who is a scientist? A scientist is any individual who uses scientific procedures to acquire knowledge and understanding.	
A. Characteristics of the scientist include:	1.1.1 Shows willingness to examine and organize objects and events in the environment.
1. An inquisitive mind.	2.1.1 Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data.
2. The ability to make accurate observations.	
3. The ability to apply critical thinking when investigating relationships and solutions to problems.	1.5.1 Recognizes the alternative factors to be considered when examining possible solutions.
4. The ability to plan carefully before beginning experiments.	1.6.2 Forms opinions only after seeking a variety of data and ideas.
5. Accuracy in experimentation.	1.5.2 Examines a variety of alternative viewpoints on scientific issues to form opinions about them.
6. Respect for the judgment of other scientists.	
7. The ability to arrive at conclusions based on evidence.	
8. The ability to organize and report results in an honest and objective way.	1.6.3 Assumes responsibility for reporting results in an honest and objective manner.

Content	Continuum Skills
	1.6.1 Understands the need to log only those data he/she has actually gathered.
B. Scientists are members of society who specialize in the study and application of science.	
1. Scientists represent men and women of every race and nationality.	1.9.2 Acknowledges that race, sex, or nationality should not constitute a barrier to scientific study.
2. Scientists learn by studying the achievements of scientists of the past.	1.9.3 Values the scientific contributions of human beings from varying cultural backgrounds.
C. There are many rewarding careers in the Physical Sciences, such as those of chemists, physicists, geologists, meteorologists, and astronomers.	1.10.1 Values the abilities, interests, and preparation required for a science-related career.
III. What tools are used by physical scientists?	
A. Scientific methods involve the use of a list of steps which suggest ways of collecting and testing knowledge. These steps include:	(Skills - II A.): The scientific method should be used in writing laboratory reports.
	4.1.2 Matches names of various processes and products of scientific inquiry with examples.
1. Making a clear statement of the problem	4.1.3 Evaluates procedures in the inquiry process that have been omitted or inadequately performed.
2. Collecting information	
3. Forming hypotheses	
4. Testing the hypotheses	
5. Gathering and recording data	
6. Analyzing the data	2.1.0 Develops ability to generate data by observing, recalling, recognizing, identifying, and measuring.

Content	Continuum Skills
7. Accepting or rejecting the hypotheses based on experimentation.	3.3.1 Makes purposeful, objective observations.
8. Recording and communicating the results.	2.1.2 Determines the need to repeat observations as a means of improving reliability. (Skills - II B.): Preparation of graphs is a very important method of describing the results of scientific exeriments.
B. Scientific notation expresses large as well as small numbers in a relatively simple manner.	3.8.3 Utilizes exponential notation to express very large and very small numbers.
C. The metric system is used for all scientific measurements and in most countries of the world.	3.7.0 Uses the metric system effectively.
1. The metric system offers several advantages:	
a. The metric system is universally understood.	
b. The metric system is based on fractional units of tenths or hundredths, which allows easy conversion of fractions to decimals.	3.8.2 Finds the mean and medium of a series of measurements. 3.8.4 Determines degree of precision of measurement and quantities derived from measurements.
2. Mathematics and measurement are important tools of the scientist.	3.8.5 Uses calculators and computers to advantage in manipulating data and solving problems.
3. Metric length is based on the meter.	3.7.2 Measures linear distances, using a metric ruler.
a. The meter can be divided into 10 decimeters or 100 centimeters or 1000 millimeters.	

Content	Continuum Skills
b. A meter is slightly longer than a yard, and an inch is equivalent to 2.54 centimeters.	
4. Metric volume is based on the liter.	3.7.4 Measures volume of liquids in a graduated cylinder marked in metric units.
a. The liter can be divided into 1000 milliliters or 1000 cubic centimeters.	
b. A liter is slightly larger than an English quart. A liter is equivalent to 1.06 quarts.	
5. Metric mass is based on the gram and kilogram.	3.7.3 Uses a balance to determine the mass of objects.
a. A kilogram equals 1000 grams.	
b. A kilogram is equivalent to about 2.2 pounds.	
c. Milligrams are used for measuring the amounts of substances in medicines and vitamins. One thousand milligrams are equivalent to one gram.	
D. The meter stick or metric ruler is used to measure metric lengths.	3.7.2 Measures linear distances, using a metric ruler.
E. The graduated cylinder is used for measuring metric volumes.	3.7.4 Measures volume of liquids in a graduated cylinder marked in metric units.
1. Graduated cylinders are usually calibrated in 1 milliliter units or 0.1 milliliter units.	

Content	Continuum Skills
2. The curved surface of a liquid in a graduated cylinder is always "read" upward and at the bottom. This curved surface is called the meniscus.	
F. The double-beam balance is used to measure accurately the metric mass of objects.	(Skills - I C. 2.): Beam balances are very delicate instruments.
1. The mass of objects is read in grams and decigrams.	3.7.1 Counts, uses numbers, and balances objects on an equal-arm balance scale.
2. Great care must be used not to overload a double-beam balance since its capacity is only 210 grams.	3.7.3 Uses a balance to determine the mass of objects.
G. Overflow cans (together with beam balances and graduated cylinders) are used in making density determinations.	3.1.2 Demonstrates growth in the ability to manipulate more complex science materials and equipment.
1. Density is the relationship of a substance's mass to its volume or D = M/V.	3.1.3 Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.
2. The mass (M) of the substance is determined by the use of the double-beam balance.	
3. The volume (V) of the water displaced in the overflow can is measured in a graduated cylinder.	
I. The periodic table of elements displays the atomic numbers, atomic masses, and electron configurations of the elements.	
J. Telescopes are used by astronomers to view distant objects.	

Content	Continuum Skills
1. Refracting telescopes contain convex lenses.	
2. Reflecting telescopes contain lenses and concave mirrors.	
K. Spectroscopes are used by astronomers to determine the elements present in heavenly bodies, their speeds, and the directions in which they are moving.	
1. In spectroscopes, prisms are used to produce a spectrum.	
2. Students can make simple spectroscopes with shoeboxes and replica diffraction grating.	
3. The Doppler Effect is observed in the red shift of the spectrum.	
L. Planetarium modes can be used to demonstrate planetary movements.	
M. Astroramas are used to identify constellations and stars and to locate them in the sky.	
N. Tuning forks are used to demonstrate sound vibrations, pitch, and frequencies.	
O. Solar batteries and radiometers are used to demonstrate how radiant energy is transformed into power.	
P. Simple machines include pulleys, inclined planes, levers, wedges, screws, and wheels-and-axles.	4.8.29 Recognizes simple machines and their functions.

Content	Continuum Skills
1. Simple machines can be used to demonstrate work, mechanical advantage, efficiency, and power.	
2. Complex machines are combinations of the six simples machines.	
Q. Thermometers are used to measure temperatures in degrees Celsius or Fahrenheit.	
R. Barometers are used to measure the pressure of air molecules striking a surface.	
S. Psychrometers are used to measure the relative humidity of the air.	
T. Mineral lights reveal ultraviolet effects on minerals and rocks.	
U. Microscopes and microprojectors are used to observe objects difficult to see with the human eye.	(Skills - I C. 1.): Microscopes are expensive and delicate instruments which should be handled with care.

UNIT TWO: MATTER

SEVEN WEEKS

Representative Objectives for This Unit

- Recognize that elements are composed of atoms.
- Recognize that matter exists as solids, liquids, and gases.
- Demonstrate that matter undergoes physical and chemical changes.
- Describe the interaction and reorganization of units of matter.

Content

I. Everything in the universe is composed of matter.

A. Matter is studied in chemistry.

B. All matter has mass (weight) and occupies space (volume).

C. All matter can be changed but not destroyed.

D. All matter can be classified into three different common states: solids, liquids, and gases.

1. Solids have a definite size and shape and a definite volume.

2. Liquids have no definite shape but a definite volume.

3. Gases have no definite shape and no definite volume.

Continuum Skills

4.8.0 Demonstrates a general knowledge of science.

4.2.0 Demonstrates understanding of basic generalizations, relationships, and principles.

(See Sample Lesson: Tools of the Chemist.)

4.8.20 Recognizes that in chemical or physical changes the total amount of matter remains unchanged.

4.8.19 Recognizes that matter exists as solids, liquids, and gases.

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Content	Continuum Skills
E. Matter can be identified by its properties.	
1. Properties of matter include color, taste, freezing point, melting point, and boiling point.	
2. Density is an important property of matter. It is the relationship of volume to mass or D=M/V in grams per cubic centimeter.	(Refer to Unit One, III G.): Overflow cans (together with beam balances and graduated cylinders) are used to measure density.
II. Elements are the basic units of matter.	
A. There are presently 106 named elements.	
1. Eighty-eight of these elements occur naturally on earth.	
2. The remaining elements are made by humans.	
B. Elements cannot be broken down into more simple substances by ordinary means.	
C. Each element is identified by a chemical symbol.	
D. Elements are arranged on a Periodic Table for scientific study.	4.2.11 Describes systems of classification used to sort items in a group of miscellaneous objects.
1. Dimitri Mendeleev, a Russian scientist, arranged the elements according to their properties.	4.2.12 Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature.
2. In updated versions of Mendeleev's Periodic Table, the elements are arranged in order of increasing atomic number in horizontal rows	

Content	Continuum Skills
called periods. Elements with similar properties are lined up in vertical columns called families.	
3. Elements are arranged on the Periodic Table as metals or nonmetals.	
E. Elements combine chemically to form compounds.	
III. Atoms are the smallest parts of elements.	(See Sample Lesson: Properties of Matter.)
A. Each element is made up of the same kinds of atoms.	
B. Atoms are made up of smaller particles.	4.2.3 Recognizes that atoms are composed of electrons, protons, neutrons, and other particles.
1. The three basic atomic particles are protons, electrons, and neutrons.	
2. There are more than one hundred different kinds of smaller atomic particles.	
C. Atoms are mostly empty space!	
D. Each atom has its own atomic number and atomic mass.	
1. The atomic number is the number of protons in the atom.	4.2.5 Illustrates that the number of atomic particles varies with each element.
2. The atomic mass is the mass of the atom, which consists mostly of its nucleus.	
E. Isotopes are atoms of the same element which differ only in the number of neutrons in their nuclei.	

Content	Continuum Skills
F. Atoms are composed of electrically charged particles.	4.2.4 Recognizes that electrons are negatively charged and protons are positively charged.
1. Protons carry a positive (+) charge.	
2. Electrons have a negative (-) charge.	
3. Neutrons are neutral.	
G. Atoms join to form molecules.	
H. Atoms and molecules are in constant motion.	4.2.6 Recognizes that matter is composed of particles which are in constant motion.
I. Differences in elements result from the differences in the number of protons.	4.2.5 Illustrates that the number of atomic particles varies with each element.
J. The properties of elements are also the result of their atomic structure.	
IV. Most substances on earth are either mixtures or compounds.	4.2.7 Describes the interaction and reorganization of units of matter and their association with changes of energy.
A. Mixtures are made of two or more elements or compounds that are not chemically combined.	
1. Mixtures can be easily separated into their component parts by such mechanical means as evaporation, distillation, filtration, decantation, or magnetism.	
2. The proportions of substances in a mixture are not definite.	
3. Some common examples of mixtures are air, smog, fog, sea water, brass, mayonnaise, and orange juice.	

Content	Continuum Skills
4. Solutions are mixtures in which the substances are uniformly mixed, such as sugar water, toothpaste, brass, and air.	
B. Compounds are composed of two or more elements that are chemically combined.	
1. Compounds cannot be separated easily by ordinary means.	
2. The proportions of elements in a compound are always definite.	
3. Compounds are identified by formulas (symbols of elements and subscripts, which denote the numbers of elements present).	
4. Some common examples of compounds are sugar, salt, the acid in vinegar, ammonia, baking soda, and all acids and bases.	4.2.0 Demonstrates understanding of basic generalizations, relationships, and principles.
5. The smallest part of a compound is a molecule.	
V. Chemical reactions are expressed in chemical equations.	
A. Chemical equations employ element symbols and compound formulas.	
B. Because chemical reactions follow the law of conservation of mass, a chemical equation must be balanced to show the same number of atoms of each element on both sides.	

Content	Continuum Skills
VI. Matter undergoes two kinds of changes: physical and chemical.	
A. A physical change is a change in the size, shape, or state of matter.	4.2.10 Identifies pairs of objects having similar properties.
1. In physical changes, the chemical formula of the substance remains the same.	4.2.7 Describes interaction and reorganization of units of matter and their association with changes of energy.
2. Melting ice, painting wood, and cutting paper are examples of a physical change.	
B. A chemical change is a change in the molecular structure of matter.	
1. In chemical changes, reactions result in new materials being formed.	
2. Substances that are formed by chemical changes have completely different properties.	
3. The tarnishing of silver and the rusting of iron are examples of chemical changes.	

Representative Objectives for This Unit

- Demonstrate the interactions between matter and energy.
- Identify examples of potential and kinetic energy.
- Describe at least four types of energy.
- Understand the definitions and interrelationships of force, work, and energy.

Content	Continuum Skills
I. Energy is the capacity to move matter from one place to another or to change matter from one substance to another.	
A. There are two states of energy: potential energy and kinetic energy.	4.2.9 Identifies examples of kinetic and potential energy.
1. Potential energy is energy in a stored condition.	(See Sample Lesson: Potential and Kinetic Energy.)
2. Examples of potential energy include water behind a dam or a stretched archer's bow.	
3. Kinetic energy is the energy of an object in motion or undergoing chemical change.	
4. Examples of kinetic energy include water released from a dam or an unleashed archer's bow.	

Content	Continuum Skills
B. Energy must be applied to do work.	
C. Energy may be changed from one form to another, but the sum of matter and energy remains the same. (The Law of Conservation of Energy.)	4.8.21 Recognizes that in nuclear reactions a loss of matter is a gain in energy; the sum of matter and energy remains constant.
D. Energy for life on earth comes from the sun.	4.8.5 Recognizes that the sun is the source of energy for green plants and that it is basic to the growth and maintenance of living organisms.
E. Energy and motion are studied in Physics.	
II. There are many forms of energy.	
A. Nuclear energy is one of the most important new sources of energy.	4.2.7 Describes interaction and reorganization of units of matter and their association with changes of energy.
1. In nuclear reactions, the nuclei of one kind of atom are changed into the nuclei of another kind of atom.	
2. There are two kinds of nuclear reactions.	
a. In nuclear fission, a heavy nucleus is split into lighter nuclei and neutrons.	
b. In nuclear fusion, light nuclei fuse together to form heavier nuclei.	
3. The sun and other stars produce energy from nuclear fusion.	
B. Heat energy is produced by the rapid movement of molecules.	

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Content	Continuum Skills
1. Heat is the kinetic energy of the molecules that make up a substance.	
2. The amount of heat a substance has depends on how many molecules it has and how fast the molecules are moving.	4.2.6 Recognizes that matter is composed of particles that are in constant motion.
3. Scientists measure heat with units called calories and joules.	
4. Temperature is the measure of the average kinetic energy of molecules in a substance.	(See Unit One, III, Q): Thermometers are used to measure temperatures in degrees Celsius and Fahrenheit.
a. Thermometers are used to measure temperature in degrees Celsius or degrees Fahrenheit.	4.2.0 Demonstrates understanding of basic generalizations, relationships, and principles.
b. The boiling point is the temperature at which a liquid changes into a gas or vapor.	
c. The freezing point is the temperature at which a liquid changes into a solid.	
d. Different liquids have different boiling and freezing points.	
e. Water boils at 100° Celsius or 212° Fahrenheit.	
f. Water freezes at 0° Celsius or 32° Fahrenheit.	
5. Most solids, liquids, and gases expand when heated and contract when cooled. Water is an exception.	

Content	Continuum Skills

6. Heat is transferred from one object to another by conduction, convection, and radiation.

C. Sound is a form of energy caused when matter vibrates.

1. Sound spreads out in all directions as waves.

2. Frequency is the number of vibrations made by a vibrating object in one second.

3. Pitch, loudness, and tone are three characteristics of sound.

a. Pitch is how low or how high a sound is and depends on the frequency of a vibrating object.

b. Loudness depends on the energy of the sound.

c. Tone depends on how the object producing the sound is vibrating.

4. The speed of sound depends on the medium through which it travels.

a. Solid objects carry sound waves at higher speeds.

b. Liquids are better conductors of sound waves than are gases like air.

Content	Continuum Skills
D. Light is a form of electromagnetic radiation.	
1. Light travels in transverse electromagnetic waves.	
2. All forms of electromagnetic radiation are part electrical and part magnetic.	
3. In addition to visible light, electromagnetic radiation includes gamma rays, x-rays, ultraviolet light, infra-red light, microwaves, and radio waves.	(See Unit One, III, K, 1.): Spectroscopes use prisms to produce a spectrum.
4. Light travels at the tremendous speed of 186,000 miles per second.	
5. The sun is the main source of light on earth.	
6. Artificial light sources include incandescent, fluorescent, and laser light.	
7. Light travels in all directions and in straight lines from its source.	
8. Light passes through transparent materials (air, gases), poorly through translucent materials (paper, frosted glass), and not at all through opaque materials (walls, books).	
9. Dark materials absorb more light energy than do light materials, which is why dark clothing is warmer than light clothing in cold weather.	

Content	Continuum Skills
10. Highly polished surfaces reflect light rays.	
11. The bending of light rays as they pass from one material to another is called refraction.	
a. Prisms are instruments which refract white light into a spectrum of colors.	
b. Prisms are components of spectroscopes.	
12. Lenses are made of transparent materials such as glass or plastic, which refract (blend) light rays.	
a. Convex lenses magnify images and converge (bend to a point) light rays.	(See Unit One, III, J, 1-2): Refracting telescopes contain convex lenses; reflecting telescopes contain lenses and concave mirrors.
b. Concave lenses diverge (spread apart) light rays.	
c. In cameras, telescopes, and microscopes, lenses are used to refract light rays.	
E. Electrical energy is a very important energy source in our daily lives.	
1. Static electricity is an electrical charge which remains stationary on one object or another.	

Content	Continuum Skills
a. Electrons of atoms are transferred from one object to another by friction.	(See Unit One, III, H): Electroscopes, Wimshurst Machines, Van de Graaff Generators, electrophoruses, and pith balls are used for various demonstrations involving electrostatics.
(1) An excess of electrons produces a negative charge of electricity on an object.	
(2) A lack of electrons results in a positive charge of electricity on an object.	
(3) The presence of an electrical charge on an object can be detected by an electroscope.	
b. The flow of electrons through gases, like air, produces an electric discharge (spark).	
(1) Electrons flow from a negative pole to a positive pole.	
(2) Lightning is a gigantic electric discharge of electrons through the air.	
2. Current electricity is produced by electrons flowing from one point to another.	
a. In order for electrons to flow, it is necessary to have a source of electrons and a force to move them.	

Content

Continuum Skills

(1) Voltage is the force which causes electrons to flow, and it is measured in volts.

(2) The flow of electrons varies in strength and is measured in amperes.

(3) Batteries and generators are common sources of electrons.

b. The path of an electric current is called a circuit.

(1) In a series circuit, the current follows one path.

(2) In a parallel circuit, the current divides and flows in two or more separate paths.

(3) A switch is used to open or close a circuit.

(4) Electric power is the amount of electrical energy that flows through a circuit at a given time and is measured in watts and kilowatts.

c. Electric current is either direct or alternating.

(1) Direct current (DC), like the current in a battery, always flows in the same direction.

(2) Alternating current (AC), like the current in a house, constantly switches directions.

Content	Continuum Skills
3. Magnetism is a force that is produced by electric charges in motion.	
a. The areas of greatest magnetic force are called magnetic poles.	
(1) Like poles of a magnet repel.	
(2) Unlike poles of a magnet attract.	
b. The magnetic field is the area around a magnet in which its magnetic force may be detected.	
c. The earth has a magnetic field.	
d. Compass needles point to earth's magnetic North Pole.	
e. Electric currents produce magnetic fields, while changes in the magnetic fields of a magnet produce electric currents.	
f. Electromagnets are magnets in which magnetism is produced by an electric current.	
III. There is a growing need for energy.	4.2.8 Recognizes the uses of fuels.
A. Fossil fuels come from the remains of plant and animal life that existed millions of years ago.	
1. Fossil fuels include coal, natural gas, and petroleum.	
2. Fossil fuels are nonrenewable resources which are rapidly becoming depleted.	4.8.25 Recognizes the value of using renewable energy.

Content	Continuum Skills
3. Most air pollution is a result of fossil fuels being burned.	
B. New energy sources must be found.	
1. Nuclear power is one of the most important new sources of energy.	
2. Geothermal energy is energy that can be collected from hot springs inside the earth.	
3. Solar energy may one day be an important energy source.	(See Unit One, III, O): Solar batteries and radiometers are used to demonstrate how radiant energy is transformed into power.
IV. Force is a push or a pull exerted on matter.	
A. Gravitational force is the attraction between the earth and objects on it.	4.8.30 Understands the definitions and interrelationships of force, work, and energy.
1. The amount of gravitational force that one object exerts on another object depends on the objects' masses and how far apart their centers are.	4.2.0 Demonstrates understanding of basic generalizations, relationships, and principles.
2. Gravitational force acts between all objects in the universe.	4.2.1 Identifies simple cause-effect relationships.
B. Electric force is the attaction between charged objects.	
1. Objects with like charges repel each other.	
2. Objects with unlike charges attract each other.	

Content	Continuum Skills
V. Work is done when a force moves an object.	
A. The amount of work done in moving an object is equal to the strength of the force used multiplied by the distance that the object moves.	4.8.30 Understands the definitions and interrelationships of force, work, and energy.
B. Work can be expressed in this formula: Work = Force x Distance.	4.8.29 Recognizes simple machines and their functions.
C. Machines are devices that help you work.	
1. All machines are made up of one or more simple machines.	
2. Simple machines are levers, pulleys, inclined planes, wedges, screws, and wheel-and-axles.	(See Unit One, III, P): Simple machines include pulleys, inclined planes, levers, wedges, screws, and wheels-and axles.
3. The advantage in using a machine is called the mechanical advantage.	

UNIT FOUR: SPACE SCIENCE — SEVEN WEEKS

Representative Objectives for This Unit

- Demonstrate knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.
- Demonstrate knowledge of the effects of moon and sun on ocean tides.
- List the planets in the solar system.
- Describe the tools astronomers use to study the universe.

Content	Continuum Skills
I. Astronomy is the science which deals with the universe.	
A. Astronomy is one of the oldest sciences.	
B. Astronomers are scientists who study the universe.	
C. Over the centuries, the work of many astronomers, such as Galileo, Copernicus, Kepler, and Newton, has contributed to our understanding of the universe.	4.5.1 Matches significant discoveries to the persons responsible for them.
II. The universe is composed of billions of galaxies.	4.8.16 Demonstrates a knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.
A. A galaxy is a huge system of millions of stars.	

Content	Continuum Skills
1. We live in the Milky Way Galaxy.	
2. Galaxies are classified according to their shapes and apparent ages: irregular, spiral, or elliptical.	
3. The Milky Way Galaxy is a spiral galaxy.	
4. According to the Doppler Effect, most other galaxies appear to be moving away from the Milky Way Galaxy at high speeds.	
B. Nebulae are great clouds of dust and gases in the universe.	
C. Pulsars, quasars, neutron stars, and black holes are other new and unusual phenomena in the universe.	
D. Scientists have several theories of the origin of the universe.	1.5.2 Examines a variety of alternative viewpoints on scientific issues to form opinions about them.
1. According to the "Big Bang Theory," all matter was exploded from a compact mass between seven and twenty billion years ago.	
2. Proponents of the "Steady State Theory," state that the universe has always been as it is today, but that new matter is constantly being produced.	
III. Stars are spheres of gases that give off energy.	4.8.16 Demonstrates a knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.
A. Constellations are patterns of stars that form an imaginary picture.	(See Unit One, III. M.): Astroramas are used for identifying constellations and stars and locating them in the sky.

Content

1. The Big Dipper and the Little Dipper are two of the most familiar constellations.

2. Other well-known and easily observable constellations are Orion, Canis Major, Taurus, Cassiopeia, Pegasus, Andromeda, Draco, and Scorpio.

3. Some constellations were named by ancient Greek and Roman astronomers; others, by modern astronomers.

B. Stars are classified according to their magnitude or brightness.

1. Absolute magnitude is the actual brightness of a star.

2. Apparent magnitude is how bright a star appears from the earth.

C. A star's color and age are related to its temperature.

1. The hottest stars are blue-white; the coolest stars are red.

2. The youngest stars are white; the oldest stars are red.

D. Stars differ in size.

1. Our sun is a medium-sized star.

2. Some stars, such as Betelgeuse and Antares, are giant stars, hundreds of times the size of the sun.

Continuum Skills

(See Sample Lesson: Constellations.)

Content	Continuum Skills
3. Other stars, such as Proxima Centauri and 61 Cygni, are dwarf stars, smaller than the sun.	
E. Distances in space are measured in light-years and parsecs.	4.8.15 Demonstrates an appreciation and understanding of time/space relationships.
1. A light-year is the distance that light travels (at a speed of 186,000 miles per second) in one year.	(See Unit One, III. B.): Scientific notation is used to express large as well as small numbers in a relatively simple manner.
2. A light-year is equivalent in distance to 9.5 trillion kilometers or six trillion miles.	
3. A parsec equals 3.26 light-years.	
4. Because of the great distances, the light from distant stars may take hundreds, or even millions, of years to reach the earth.	
5. Scientific notation is a helpful method of expressing great distances in space.	
IV. The sun is the star nearest the earth.	
A. The sun is about 93,000,000 miles or 150,000,000 kilometers from the earth.	
B. The sun is a medium-sized, yellow star of medium temperature.	
C. The sun is the center of our solar system.	
D. The sun is the source of energy for life on the earth.	4.8.5 Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms.

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Content	Continuum Skills
E. Solar features include sunspots, solar flares, and solar prominences.	
V. Planets, moons, asteroids, comets, and meteoroids follow regular and predictable orbits around the sun.	4.8.13 Recognizes that the motion and path of celestial bodies are predictable.
A. There are nine known planets orbiting the sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.	4.8.16 Demonstrates knowledge of basic difference between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.
1. The sun's gravity holds these planets in orbit around it.	(See Unit One, III. L.): Planetarium models can be used to demonstrate planetary movements.
2. The planets rotate on their axes (determining a day) and revolve around the sun in orbits (determining a year).	
3. The tilt of the earth produces its seasons.	
4. Mercury is the smallest planet; Jupiter is the largest planet.	
5. Saturn is so light that it could float on water.	
6. Three planets--Jupiter, Saturn, and Uranus--are now known to have rings around them.	
B. Moons are the natural satellites of planets.	
1. Most planets, with the exception of Mercury, Venus, and possibly Pluto, have moons.	
2. Earth is the only planet known to have only one moon.	

Content	Continuum Skills
3. Jupiter has 15 known moons, and Saturn has at least 20.	
C. Earth's moon rotates and revolves in orbit around the earth every lunar month.	4.8.14 Describes the regular movements of the earth and moon.
1. The various phases of the moon are caused by the changing position of the moon in relation to the sun.	
2. The moon shines by reflected sunlight.	
3. Solar and lunar eclipses occur as the result of the relative positions of the sun, moon, and earth.	
4. The moon and earth affect each other's motions.	
5. The pull of the moon on the earth's waters produces tides.	4.8.18 Demonstrates a knowledge of the effects of moon and sun on ocean tides.
D. Asteroids may be fragments of a planet which once orbited between Mars and Jupiter.	
E. Comets follow regular and predictable orbits around the sun.	
1. If comets collide with other astronomical bodies, they disintegrate into fragments called meteoroids.	
2. Halley's Comet is predicted to pass near the earth in 1986.	
F. Meteoroids are called meteors if they enter the earth's atmosphere and meteorites if they reach the earth's surface.	

Content	Continuum Skills
VI. Scientists have sent many artificial satellites into space.	4.8.17 Cites some of the accomplishments in humankind's exploration of space.
A. Mercury was the U.S.'s first spacecraft.	
B. Gemini established our ability to remain in space for long periods of time.	
C. Apollo spacecrafts landed men on the moon.	
D. The Sky Lab was our first laboratory in space.	
E. Voyager spacecraft have taken spectacular photographs of Jupiter and Saturn and are programmed to continue on to Uranus.	
F. The space shuttle has taken the U.S. into the age of the utilitarian use of space.	
VII. The astronomer uses many instruments to study the universe.	4.3.1 Gives examples of ways in which the use of scientific knowledge has affected society.
A. Optical telescopes are important instruments used for space observations.	(See Unit One, III, J.): Telescopes are used by astronomers for viewing distant objects.
1. In refracting telescopes, lense are used to form images of astronomical bodies.	
2. In reflecting telescopes, lenses and mirrors are used for viewing objects in space.	
B. Radio telescopes have recently been developed to read the radio waves received from outer space, and they have detected quasars and pulsars.	

Content	Continuum Skills
C. Spectroscopes are instruments used to separate light into bands of colors, called spectra. 1. Spectroscopes contain lenses and prisms to produce spectra. 2. By studying the spectra produced by spectroscopes, astronomers are able to determine the composition of astronomical bodies, as well as the speeds and directions in which they are moving. 3. The Doppler Effect is used to explain the "red shift" in spectral lines, indicating how rapidly bodies are moving and their direction of movement.	(See Unit One, III, K.): Spectroscopes are used by astronomers for determining the elements present in heavenly bodies, their speeds, and the directions in which they are moving.

UNIT FIVE: EARTH SCIENCE

SEVEN WEEKS

Representative Objectives for This Unit

- Describe the earth's layers.
- Describe the composition of the earth.
- Identify forces that are constantly changing the earth's surface.
- Explain the theory of plate tectonics.

Content	Continuum Skills
I. Geology is the study of the earth's origin, age, structure, and composition.	
A. No one knows how the earth began, but proponents of one theory, the "Dust Cloud Theory" (Kuiper), state that the earth and solar system developed from a large mass of rotating gas and dust.	
B. Geologists believe the earth is 4.5 billion years old.	
C. Geologists use many methods to determine the earth's age and history including:	4.6.1 Identifies how modern techniques of determining the age of specimens contribute to knowledge of earlier civilizations.
1. Radioactive dating	
2. Study of arrangements of rock layers	
3. Study of fossil deposits	
D. Geological evidence indicates that the earth has had a long and turbulent history and has undergone many changes.	4.8.22 Recognizes that there are continuous changes on earth.
II. The earth is made up of three main layers:	

Content:	Continuum Skills
A. The Crust, a relatively thin layer of solid rock.	
B. The Mantle, which makes up 84 percent of the earth's volume and about two-thirds of its mass.	
C. The Core, which makes up 15 percent of the earth's volume and about one-third of its mass.	
III. Forces are constantly changing the earth's surface.	4.8.22 Recognizes that there are continuous changes on earth.
A. Some forces constantly push up the earth's surface to form mountains, hills, plateaus, and mesas.	
1. The Folding process is one way that mountains are formed.	
a. Anticlines are upward folds of rock layers.	
b. Synclines are downward folds of rock layers.	
c. The Appalachians, Alps, and Himalayas are examples of folded mountain ranges.	
2. Faulting is another mountain-building process.	4.8.22 Recognizes that there are continuous changes on earth.
a. A fault is a break in the earth's surface.	
b. Earthquakes and volcanoes are concentrated along major fault lines.	

Content

c. Seismographs are instruments which measure earthquakes and volcanic activity.

d. The San Andreas Fault is a major fault system in California.

3. Volcanoes are mountains made from liquid rock called magma, ash, and rocks.

a. Mount St. Helens (Washington, U.S.A.) and Mount Fuji (Japan) are composite volcanoes, built of lava, solid rock, and ash.

b. Paricutin (Mexico) and Sunset Crater (Arizona, U.S.A.) are cinder cones built of rock and ash.

c. Mauna Loa and Mauna Kea (Hawaii) are shield volcanoes built by series of lava flows.

d. Volcanoes are described as "active," "dormant," or "extinct."

B. Other forces constantly wear away the earth's surface.

1. Weathering is the process which causes rocks on the earth's surface to break apart.

2. Erosion is the process of breaking up and carrying away earth's materials by the action of water, wind, and ice.

Continuum Skills

3.4.2 Gathers information from science textbooks, reference materials, films, and television.

Content	Continuum Skills
a. Running water is the most important agent of erosion.	
b. Glaciers, avalanches, and landslides erode mountains.	
c. Wind is also an important eroding agent.	
IV. The earth's surface is composed of rocks, minerals, and soil.	3.4.2 Gathers information from science textbooks, reference materials, films, and television.
	(See Unit One, III, T.): Mineral lights reveal ultraviolet effects on minerals and rocks.
A. Minerals are naturally occurring inorganic substances.	
1. Minerals generally occur as crystals.	
2. Minerals can be identified by their properties, such as color, streaks, luster, hardness, cleavage, fracture, and density.	
B. Rocks of the crust are composed of minerals and mixtures of compounds and elements.	4.8.23 Recognizes that rocks contain one or more kinds of minerals.
1. There are three types of rock.	4.8.24 Recognizes the three major types of rocks that make up the earth.
a. Igneous rocks are formed by the process of cooling magma. Basalt, granite, and lava are examples of igneous rock.	(See Sample Lesson: Rock Identification.)
b. Sedimentary rocks are formed by the processes of compaction and cementation of igneous rock sediments. Sandstone and limestone are examples of sedimentary rock.	

Content	Continuum Skills
c. Metamorphic rocks are formed when igneous or sedimentary rocks are subjected to great heat and pressure. Slate, schist, gneiss, and marble are examples of metamorphic rock.	
2. All types of rock originated from magma.	
3. Igneous rock may be changed into either sedimentary or metamorphic types (the rock cycle).	
4. The study of rock deposits, their formation, and how they were formed in layers reveals much about the earth's history.	
V. Plate tectonics is the most recent explanation of the way in which the earth's crustal features were formed.	4.8.22 Recognizes that there are continuous changes on earth.

UNIT SIX: WEATHER

FOUR WEEKS

Representative Objectives for This Unit

- Identify major factors that cause weather changes and patterns.
- Measure temperature in degrees Celsius and Fahrenheit.
- Identify the earth's major climates.

Content

I. The atmosphere is a sea of air which surrounds the earth.

A. The atmosphere has several layers.

1. The layer nearest earth is the troposphere.

a. This is the layer in which people live.

b. The troposphere contains about 75 percent of all gas in the atmosphere.

c. Winds, air currents, and clouds affect the troposphere more than do all the other layers of the atmosphere.

2. Other layers include the stratosphere, the mesosphere, the thermosphere, the exosphere, and the ionosphere.

B. The atmosphere is composed of gases, mostly nitrogen (78 percent), oxygen (20.9 percent), carbon dioxide, argon, and water vapor.

1. Like all matter, the gases of the air have both mass and volume.

Continuum Skills

2.4.0 Participates in scientific inquiry at the appropriate level.

3.4.2 Gathers information from science textbooks, reference materials, films, and television.

Content	Continuum Skills
2. The mass of air presses down on the earth's surface with a pressure of about 1 kg/cm^2 at sea level.	
3. Air pressure is measured by mercurial and aneroid barometers.	(See Unit One, III R.): Barometers measure the pressure of air molecules striking a surface.
4. High air pressure is associated with dry air masses and fair weather.	
5. Low air pressure is usually associated with cloudy weather and precipitation.	
6. Temperature is a measure of the energy of molecular motion of gases.	
7. Temperature is measured with a thermometer in degrees Celsius or Fahrenheit.	(See Unit One, III Q.): Thermometers are used to measure temperatures in degrees Celsius or Fahrenheit.
C. Air masses are large bodies of the atmosphere which have uniform temperatures and moisture content.	
1. The weather in an air mass depends on three things:	4.8.26 Identifies major factors that cause weather changes and patterns.
a. The temperature and moisture conditions of the air mass.	
b. The temperature and moisture conditions of the land area over which the air mass has moved.	
c. How rapidly the air mass has moved.	
2. Air masses form in source regions where they acquire the temperature and moisture content similar to those of the region.	

Content	Continuum Skills
a. Continental polar air masses bring cold air from Canada into the northern part of the United States.	
b. Continental tropical air masses bring hot dry weather from the hot dry areas of the southwestern United States.	
c. Maritime polar air masses are the moist, cool air masses which come from the northern Atlantic and northern Pacific oceans.	
d. Maritime tropical air masses originate in the mid-Atlantic, the Caribbean, and the Pacific and bring hot, humid weather.	
3. The leading edge of a moving air mass is called a front.	
a. A cold front is located at the front edge of a moving mass of cold air.	
b. A warm front is located at the front edge of a moving mass of warm air.	
c. A stationary front is an unmoving zone between two air masses.	
D. The amount of water vapor in the air affects the weather.	4.8.26 Identifies major factors that cause weather changes and patterns.
1. The amount of water vapor in the air determines humidity.	
2. Relative humidity is the percentage of water in the atmosphere at a certain	

Content	Continuum Skills
temperature as compared to how much water could be in the atmosphere at the same temperature.	
3. Relative humidity can be measured with a psychrometer, which is made of dry and wet bulb thermometers.	
4. The water cycle includes evaporation, condensation, and precipitation.	
a. Evaporation is the changing of water to water vapor.	
b. Condensation is the changing of water vapor to water.	
c. Precipitation occurs when water falls to the earth's surface in either solid or liquid forms, such as in the form of snow or rain.	
5. Clouds are mostly tiny droplets of water suspended in the air.	
a. Clouds are named for their shapes and height.	
b. The three basic cloud shapes are cumulus, stratus, and cirrus.	
II. Weather predictions are made by meteorologists.	(See Sample Lesson: Weather Recording.)
A. Weather forecasts are made from information collected about air mass movements, fronts, and areas of high pressure and low pressure.	
B. Storms can occur rapidly and often bring violent changes in the weather.	4.8.27 Identifies the effect of weather on the local environment.

Content	Continuum Skills
1. A tornado is the most violent storm that occurs on earth.	
2. Hurricanes are huge, violent, circular storms.	
C. Local and national weather conditions can be determined by reading weather maps.	
III. The average of the many kinds of weather that occur in a region over a long period of time is called the climate.	3.4.3 Finds sources of information needed to solve a problem related to a specific topic.
A. Temperature and precipitation are the two most important factors that determine climate.	
B. The three major earth climates are polar, temperate, and tropical.	
C. Climates are modified by altitudes, ocean currents, large bodies of water, and mountains.	4.2.2 Uses cause-effect relationships to make a prediction.
D. Smog has a serious effect on the climate of cities.	1.4.2 Develops and expresses an opinion on a social issue.

UNIT SEVEN: OCEANOGRAPHY — TWO WEEKS

Representative Objectives for This Unit

- Explain the causes of ocean waves.
- Discuss current research in oceangraphy.
- Explain how living organisms are affected by the oceans.
- Identify the main areas of the ocean floor.

Content	Continuum Skills
I. Oceanography is the study of the oceans of the earth.	4.8.0 Demonstrates general knowledge of science.
A. Special instruments enable scientists to explore the ocean depths.	3.4.2 Gathers information from science textbooks, reference materials, films, and television.
1. Echo soundings use sound signals to find the depth and the shape of the ocean floor.	2.3.1 Examines environmental issues, pointing out contradictions and discrepancies in the positions of various groups.
2. A bathyscaph is a submarine observatory which enables oceanographers to explore the ocean depths and to study oceanic life.	4.8.8 Describes examples of humankind's dependence on and interference with natural ecosystems.
B. Research is being conducted into the ocean's nature and conditions, which represent a modern frontier for investigation.	(See Sample Lesson: The Ocean's Floor.)
II. The ocean floor can be divided into three main areas.	
A. The continental shelf is a shallow area which surrounds continents.	

Content	Continuum Skills
B. The continental slope plunges rapidly to the bottom of the ocean and contains valleys and canyons.	
C. The ocean basin is the ocean's bottom and contains volcanoes, mountains, and deep trenches.	
III. Ocean waves are caused mostly by wind, earthquakes, and tides.	
A. Wind is the most important maker of waves.	
B. Tides are caused by the attraction of the moon and sun.	
C. Tsunamis are waves made by undersea earth movements.	
IV. Ocean currents are moving streams of water in the ocean.	
A. Currents affect the weather, food supply, and coastal features.	
B. There are warm currents and cold currents.	
C. The Gulf Stream and the California Current both carry huge volumes of water for great distances.	
V. Life in the ocean is very diverse.	1.3.2 Appreciates the interdependence of living organisms in the natural environment and the implications for continued survival.
A. All animal phyla are represented in the ocean.	
B. The greatest marine life population is found near the shorelines of the continents.	

LESSON PLANNING

Successful teaching begins with careful planning, and the sample lessons which appear on pages 54-105 will assist with this process.

The lesson plans follow the format of the seven-point, teacher-directed instructional sequence. The questions below will need to be addressed when a teacher is designing an instructional sequence.

- What is the specific objective, and how will it be presented to the students?
- What is the value in achieving the objective?
- What learning activities must be modeled, explained, or illustrated for students?
- What guided group practice will be provided for the students?
- What independent practice or activity will be provided for the students?
- What provisions will be made for individual differences in learning styles?
- How will the lesson be evaluated?

SAMPLE LESSON I: TOOLS OF THE CHEMIST

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Students will be able to identify important tools of the chemist and understand their uses.

Skills Emphasized: Speaking, writing, reading, listening, identifying

Thinking/Cognitive Skills: Application

1. Specific Objective

   Students will be able to identify various tools used by chemists and also understand how these tools are used by chemists.

2. Value to Students

   Students will become familiar with the names and uses of laboratory tools which they will use in laboratory experimentation.

3. Initial Instruction/Teacher Presentation

   Teacher prepares a worksheet with pictures of various tools of the chemist and spaces in which the student can enter the names and uses of these tools.

   Teacher then exhibits the various tools, writes their names on the chalkboard or shows them on an overhead projector, and asks students what they think might be their uses.

   With student participation, teacher demonstrates the uses of the tools.

   Teacher may also prepare overhead transparencies or flash card drawings of the tools for class participation in identification.

   Materials Needed

Flasks	Bunsen burners	Pipettes	Filter paper
Beakers	Alcohol lamps	Graduated cylinders	Litmus paper
Ring stands	Wire gauze	Clamps	

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4. Guided Group Practice

Students are grouped in teams. The tools of the chemist are exhibited by the teacher. One student in each group identifies the tool and another describes its uses. (This activity may also be used as a group game.)

5. Independent Practice

Students are given a worksheet showing various tools of the chemist to identify from brief descriptions.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Filmstrips, additional reinforcement with flashcards, name and use review with other students, picture puzzles

Enriched/supplemental activities: Filmstrips, picture puzzles, word search puzzles, "Can you spell the tool word?," "Unscramble the word," etc.

Ask students to look through scientific equipment catalogs and find additional tools that may be used by the chemist, to draw pictures of them, and to describe their uses.

7. Evaluation

Responses to identifying the names and uses of the tools

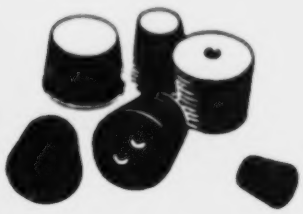
Identification quiz

Teacher observation of student vocabulary and assessment of student's knowledge of the uses of tools

Chemist: _____

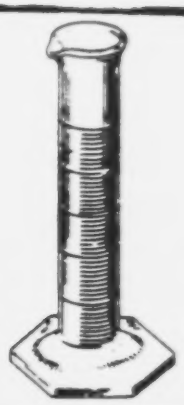
TOOLS OF THE CHEMIST

Per. ____ Table ____

Tool	Name	Uses
		

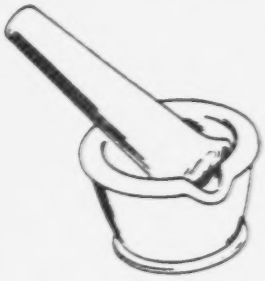
56

TOOLS OF THE CHEMIST (CONT.)

Tool	Name	Uses
		

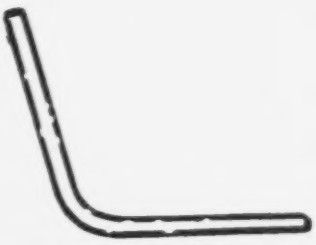
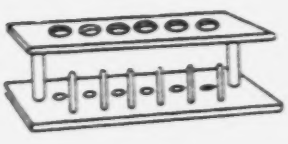
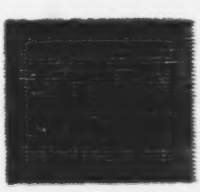
57

TOOLS OF THE CHEMIST (CONT.)

Tool	Name	Uses
		

58

TOOLS OF THE CHEMIST (CONT.)

Tool	Name	Uses
		
		
		

TOOLS OF THE CHEMIST: IDENTIFICATION REVIEW

Chemist: _____

Per. ___ Table ___

1.

2.

3.

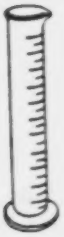
4.

5.

6.

7.

8.

9. 

10.

11.

12.

13.

1. _ _ _ _ _ _ _ _ _

2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

3. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

4. _ _ _ _ _ _ _ _

5. _ _ _ _ _ _ _

6. _ _ _ _ _ _ _ _ _ _ _ _

7. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

8. _ _ _ _ _ _ _ _ _ _ _ _ _

9. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

10. _ _ _ _ _ _ _ _ _ _

11. _ _ _ _ _ _ _ _ _ _ _ _ _

12. _ _ _ _ _ _

13. _ _ _ _ _ _

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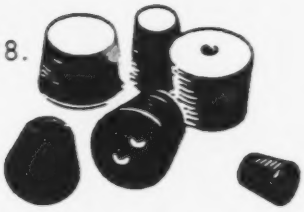
TOOLS OF THE CHEMIST: IDENTIFICATION REVIEW (CONT.)

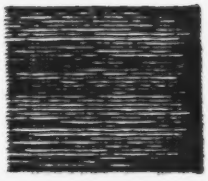
14.

15.

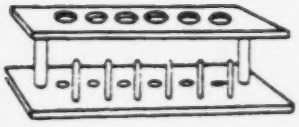
16.

17.

18. 

19. 

20.

21. 

22.

14. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

15. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

16. _ _ _ _ _ _ _ _ _ _ _ _ _ _

17. _ _ _ _ _ _ _ _ _ _ _ _ _ _

18. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

19. _ _ _ _ _ _ _ _ _ _ _ _

20. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

21. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

22. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Chemical Tool Expert: _____

Per. _____ Table _____

NAME THE CHEMICAL TOOL!

1. It measures liquid volume: _____
2. Flask with a round bottom: _____
3. Flask first used in Germany: _____
4. Glass container used for pouring and mixing chemicals: _____
5. A low efficiency heat source: _____
6. A high efficiency heat source: _____
7. Two tools used to grind chemicals: _____ and _____
8. An adjustable support: _____
9. Used for stirring mixtures: _____
10. Used for testing chemical reactions: _____
11. It cleans test tubes and flasks: _____
12. Transport tubing, rigid: _____
13. Transport tubing, flexible: _____
14. Used for cutting glass tubing: _____
15. Heat source used for bending glass tubing: _____
16. Used for adding small amounts of liquids: _____
17. It contains about 1 milliliter of liquid: _____
18. Two kinds of stoppers for flasks and test tubes: _____ and _____

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NAME THE CHEMICAL TOOL (CONT.)

19. It holds test tubes, especially when heating them: _____

20. Used for storage of test tubes: _____

21. It distributes heat under glassware: _____

22. Used to pour liquids into container with small openings; usually inserted into a rubber stopper: _____

23. Two kinds of flasks: _____ and _____

CAN YOU SPELL THE CHEMICAL TOOL WORD? (Refer to Questions 1 to 23 above.)

1. __ R __ __ __ __ __ __ __ __ __ L __ __ __ __ __
2. __ __ L __ __ __ __ __ E __ __ L __ __ __
3. __ EA __ __ __
4. F __ __ __ __ __ __ __ F __ __ __ __
5. __ __ __ __ TT __
6. R __ __ __ __ __ __ U __ __ __ __
7. __ __ __ SS __ __ B __ __ __
8. __ U __ __ __ __ __ U __ __ __ __
9. A __ __ __ __ __ __ __ A __ __
10. __ I __ __ __ __ __ __ D
11. T __ __ __ T __ __ T __ __ __
12. __ __ __ RR __ __ __ R __ __
13. T __ __ __ T __ __ __

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CAN YOU SPELL THE CHEMICAL TOOL WORD? (CONT.)

14. _ _ _ T _ _ _ E _ _ _ _ H
15. _ _ _ T _ _ and _ _ _ T _ _
16. _ _ BB _ _ _ _ _ PP _ _
17. _ _ _ K _ _ _ PP _ _
18. _ RI _ _ _ _ _ _ _ _ I _ _
19. T _ _ _ _ _ _ E _ _ _ K
20. _ _ _ E _ _ _ _ E

CAN YOU UNSCRAMBLE THESE CHEMICAL TOOL WORDS?

1. Tdagruaed Diyclner _____
2. Leremneeyr Lfask _____
3. Ebut Tset _____
4. Nubsen Rubner _____
5. Eabekr _____

Puzzled? _____

Per. ____ Table ____

TOOLS OF THE SCIENTIST WORD SEARCH

E T T E P I P R F O E K A L F
Z R E T L I F A E L T S E P F
I L L R T U E J E L O A G E I
R P A E N O I L B E O L A B L
P M T N N O I L U H L F M U E
M A E R U M M E T S S E O T P
A L I U U B E B T I G C R U O
L C U B U N N Y S D N N T R C
L O G N I B U T E I O E A E S
O E R E R O B T T R T R R P O
H D F S U N O U A T F O E P R
O I I N B N O C U E L L K O C
C L L U O E K E E P A F A T I
L S E B U T Y H S U R B E S M
A D N A T S G N I R E O B O K

Can You Find These?

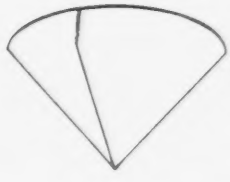
File (2)
Petri Dish
Borer
Y-tube
U-tube
Rack
Tongs
Microscope
Tools
Beaker
Erlenmeyer Flask
Florence Flask
Bunsen burner
Funnel
Ring Stand
Stopper
Pestle
Pipette
Test tube
Tubing
Clamp
Alcohol lamp
Brush
Bell jar
Filter
Slide

65

Can You Identify These?

C _ _ _ _ B _ _ _ _ _

_ _ _ _ _ _



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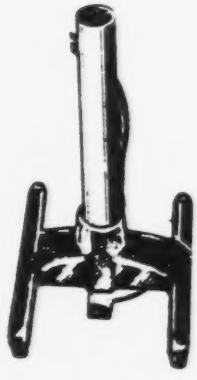


_ _ _ _ _ _ _

_ _ _ _ _ _ _

SPELL THE NAMES OF THE FOLLOWING TOOLS: (See words in puzzle.)

1. _ _ _ _ _ NM _ _ _ _ _ _ L _ _ _ _
2. _ U _ _ E _
3. _ I _ _ _ _ _ _ _ D
4. _ _ R _ R
5. _ _ _ T _ _
6. S _ _ _ E
7. _ _ _ K
8. _ _ _ _ _ I _ I _ _
9. _ _ _ K _ _
10. _ _ _ PP _ _
11. _ _ _ T T _ _ _
12. _ _ _ O _ O _ _ _ _ _ _
13. _ _ _ _ P
14. _ R _ _ _
15. _ _ _ _ TT _
16. _ L _ _ _ _ _ _ _ _ L _ _ _
17. T _ _ _ _
18. B _ _ _ _ _ _ B _ _ _ _ _ _
19. _ _ _ _ LE
20. _ O _ _ A _
21. _ _ _ _ O _ _ O _ _
22. _ _ _ _ J _ _

Can You Identify These?

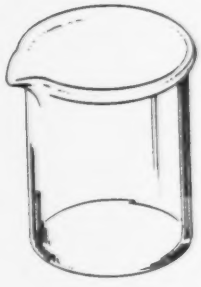
_ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _

99

_ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _



_ _ _ _ _ _ _

_ _ _ _ _ _ _

_ _ _ _ _ _ _

SAMPLE LESSON II: PROPERTIES OF MATTER

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Students will be able to identify different substances by their properties.

Skills Emphasized: Observing, speaking, writing, reading, listening

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to understand how substances are identified by their various properties.

2. Value to Students

   Students become aware that different forms of matter have specific properties which identify them.

3. Initial Instruction/Teacher Presentation

   Teacher introduces subject with overhead transparencies, which describe the many different properties matter can have; students record the definitions of these properties on an activity sheet.

   Teacher prepares various sample bottles or test tubes of substances for students to examine.

   With student participation, teacher demonstrates some properties of these substances.

   Demonstrations might include: (1) flame test for salt, (2) flame test for copper sulfate, (3) smell test for alcohol, (4) smell test for vinegar, (5) smell test for ammonia, (6) taste tests for sugar and salt, (7) smell test for natural gas, (8) carbon dioxide test for lime water, (9) smell test for sulfur, (10) solubility tests for sulfur, iron filings, sugar, salt.

   Materials Needed

Water	Coal	Sugar	Lime water
Vinegar	Natural gas	Iron filings	Copper wire
Alcohol	Mercury	Sulfur	Small glass bottles or test tubes
Ammonia	Salt	Copper sulfate	Lables for bottles

4. Guided Group Practice

After teacher and student-assisted demonstrations, the students record observations on an activity sheet.

The activity sheet should include: state, conductivity, luster, color, hardness, solubility, flame tests, combustibility, freezing points, boiling points, odor, density, taste, etc., where appropriate for the various substances.

Students identify the substances from descriptions of their properties.

5. Independent Practice

Students are given a class assignment in which they determine the differences in the properties of similar substances and the differences and similarities in the properties of various other substances.

6. Individual Differences

Remediation/alternative activities: Students view flashcards showing pictures of two different substances to determine how their properties make them different.

Enriched/supplemental activities: Students name common substances, listing as many properties as possible for each substance. (Use reference books.)

Students make a series of flashcards of two different or similar substances; and, on the back of each card, list the properties which make the substances similar but different.

Students solve Word Search Message Puzzle based on observations from the demonstrations. (See example on page 65.)

7. Evaluation

Review of students' completion of the activity sheet

Class discussion of the independent practice assignment

Results of teacher-prepared quiz based on demonstrations and observations

Property of _____

Per. ____ Table ____

PROPERTIES OF MATTER

Read "Properties of Matter" in Principles of Science, Book I (4th Edition).

1. _____, _____, _____, and _____ are some properties of matter.

2. The _____ of a substance are the qualities that _____

_____

3. What properties of glass make it different from wood? (THINK!)

Glass: _____

_____

_____

Wood: _____

_____

_____

4. The use of a substance depends _____.

You look for a _____. You drink _____, such as _____. Wool is used in winter clothes because _____.

Airplanes are made of aluminum metal because of _____ _____ _____. Copper, a reddish-brown metal, is used to make _____ because it is a _____ _____.

5. What properties allow you to tell the difference between each of the following pairs?

a. Rubber _____

Aluminum _____

b. Chalk _____

Snow _____

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c. Coca Cola _____

Water _____

d. Salt _____

Sugar _____

e. Wood _____

Plastic _____

f. Aluminum _____

Iron _____

6. Name one use for the following substances. The uses of substances depend upon their properties!

a. Rubber _____

b. Wood _____

c. Chalk _____

d. Water _____

e. Salt _____

f. Sugar _____

g. Plastic _____

h. Aluminum _____

i. Iron _____

7. Define the following properties of matter:

a. Color: _____

b. Odor: _____

c. Taste: _____

d. Luster: _____

e. Hardness: _____

f. Conductivity: _____

g. Combustibility: _____

h. Solubility: _____

PROPERTIES OF MATTER (CONT.)

i. Density: _____

j. Boiling point: _____

k. Freezing point: _____

l. Melting point: _____

PROPERTIES OF SOME COMMON SUBSTANCES

Water

State: _____ Color: _____

Taste: _____ Boiling point (°C): _____

Freezing point (°C): _____ Odor: _____

Density: _____

Coal

State: _____ Color: _____

Combustibility: _____

Solubility: _____

Hardness: _____ Luster: _____

Natural Gas

State: _____ Color: _____

Odor: _____ Combustibility: _____

Mercury

State: _____ Color: _____

Luster: _____ Density: _____

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WHAT'S THE PROPERTY WORD?

1. A liquid metal? _ _ _ _ _ _ _ _

2. Liquid, solid, or gas? _

3. Temperature at which a substance freezes:

   _

4. Temperature at which a substance melts: _

5. Temperature at which a substance boils: _

6. How a substance shines in the light: _ _ _ _ _ _ _

7. How a substance reflects light: _ _ _ _ _ _

8. Bitter, sour, sweet, salty: _ _ _ _ _ _

9. It boils at 100°C and freezes at 0°C: _ _ _ _ _ _

10. Its density is 13.6: _ _ _ _ _ _ _ _

11. Its density is 1.0: _ _ _ _ _ _

12. The relationship of mass to volume: _ _ _ _ _ _ _ _

13. Qualities of a substance which make it different from other substances:

    _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

14. It depends upon its properties: _ _ _ _ of substance.

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Property of _____

Per. _____ Table _____

MORE PROPERTIES OF MATTER

Examine samples of salt, sugar, iron filings, sulfur, copper sulfate and lime water.

Salt (NaCl)

State: _____ Color: _____

Odor: _____ Taste: _____

Luster: _____ Solubility: _____

Color in flame: _____

Sugar ($C_{12}H_{22}O_{11}$)

State: _____ Color: _____

Odor: _____ Taste: _____

Luster: _____ Solubility: _____

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Iron Filings (Fe)

State: _____ Color: _____

Odor: _____ Luster: _____

Solubility: _____

Reaction in flame: _____

Sulfur (S)

State: _____ Color: _____

Luster: _____

Odor (When burning) _____

Solubility: _____

MORE PROPERTIES OF MATTER (CONT.)

Copper Sulfate ($CuSO_4$) (Caution: Poisonous!! Do Not Touch!!)

State: _____ Color: _____

Luster: _____ Solubility: _____

Color in flame: _____

Lime water ($CaOH + H_2O$) Color: _____

State: _____

Color (in presence of carbon dioxide): _____

Copper wire (Cu)

State: _____ Color: _____

Luster: _____

Conductivity: _____

Hardness: _____

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WHAT IS IT?

1. Its color is blue. _____
2. It turns milky white in the presence of carbon dioxide. _____
3. It is ductile. _____
4. It is poisonous. _____
5. It burns with an orange flame. _____
6. It burns with a green flame. _____
7. It smells like rotten eggs when heated. _____
8. Its color is yellow. _____
9. It tastes sweet. _____
10. How different substances are identified: _____

Property of _____

Per. ____ Table ____

PROPERTIES OF MATTER MESSAGE PUZZLE

Find the correct word. If a number is beneath a certain letter, place that letter in the appropriate space in the message which follows.

1. Color of salt: _ _ $\underset{1}{_}$ _ _
2. The luster of sulfur: $\underset{3}{_}$ _ _ _
3. A liquid metal: _ _ _ $\underset{12}{_}$ _ _ _
4. The color of copper sulfate in a flame: _ $\underset{6}{_}$ _ _ _
5. A substance very soluble in water: _ _ _ _
6. A yellow powder: _ _ _ $\underset{4}{_}$ _ _
7. The color of salt in a flame: _ _ _ _ _ $\underset{5}{_}$
8. A substance that did not mix with water: _ _ _ _ _ _
9. They sparkled in the flame: _ _ _ _ _ _ _ _ _ $\underset{7}{_}$ _ _
10. The ability of a substance to dissolve in water. $\underset{9}{_}$ _ _ _ _ _ _ _ _ _ _
11. How a substance looks in light: _ $\underset{2}{_}$ _ _ _ _
12. Color of copper sulfate: $\underset{10}{_}$ _ _ _
13. Luster of mercury. _ _ _ _ _
14. Substance that smelled like rotten egg when ignited. _ _ _ _ _ _
15. 13.6 times as heavy as water: _ _ _ _ _ _ _
16. The relationship of mass to volume: _ _ _ _ _ $\underset{8}{_}$ _

75

PROPERTIES OF MATTER MESSAGE PUZZLE (CONT.)

17. Whether a substance is soft or brittle or bendable: 14 _ _ _ _ _ _ _ _

18. How a substance smells: 16 _ _ _

19. The identifying characteristics of matter: 15 _ _ _ _ _ _ _ _ _ _

20. Whether a substance burns easily:

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

21. Whether a substance is sweet, bitter, sour, or salty: _ 11 _ _ _

THE MESSAGE

3 1 4 4 5 6 5 7 8

9 2 10 9 8 11 7 12 5 9

11 6 5 1 3 5 7 8 1 4 1 5 3

10 13 8 14 5 1 6

15 6 16 15 5 6 8 1 5 9

76

Chemist: _____

Per. ____ Table ____

MATTER AND TEMPERATURE

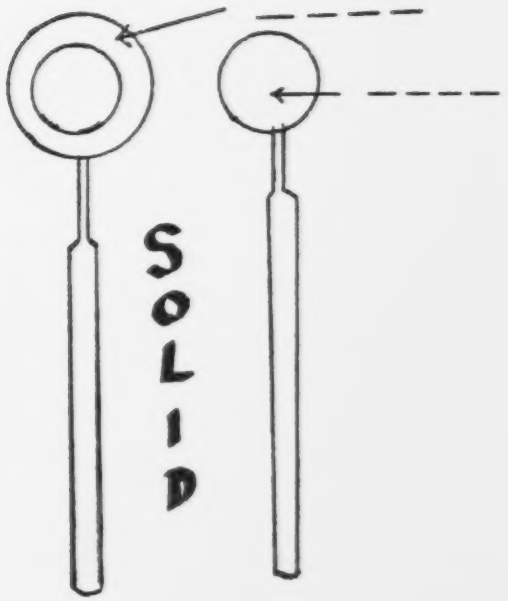
Procedures: (See transparency.)

1.

2.

3.

4.



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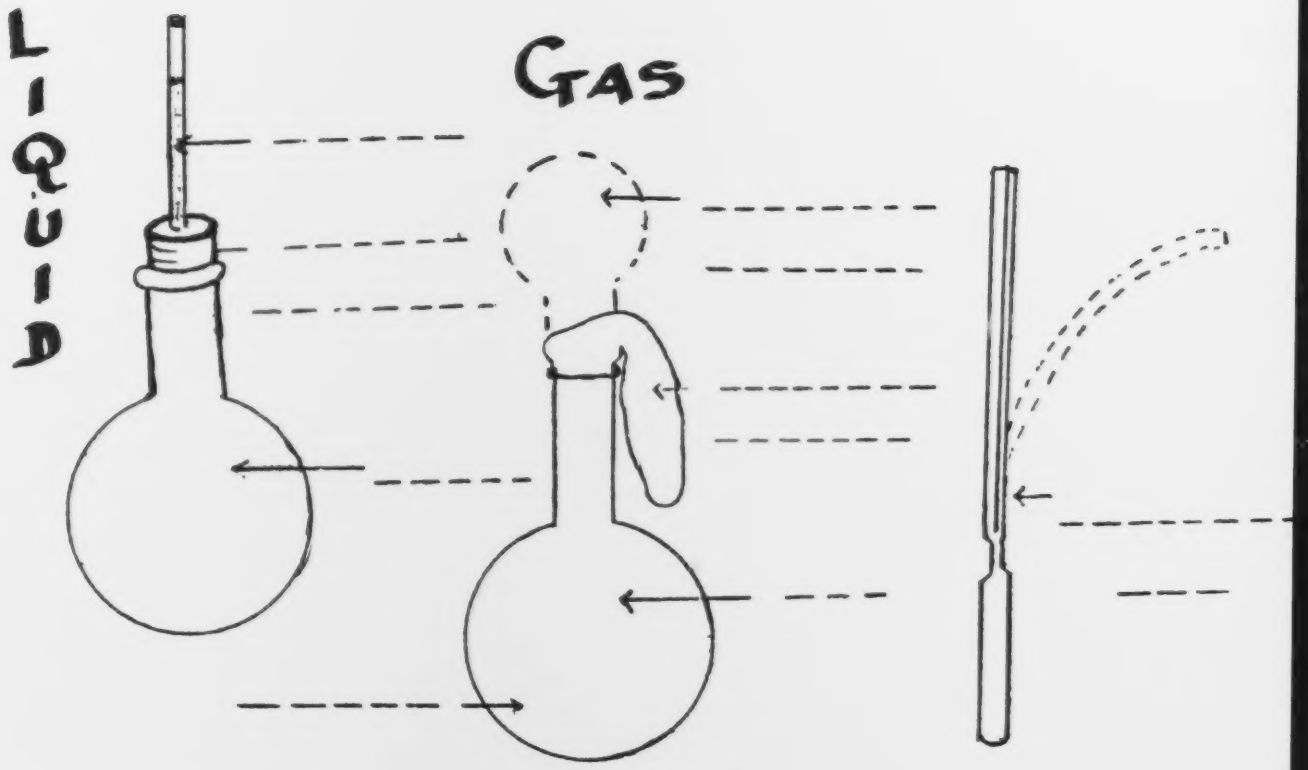

OBSERVATIONS AND QUESTIONS ABOUT MATTER

1. What is matter?
2. What are the three states of matter?
3. What two things do all three states of matter have in common?
4. What is a solid?
5. What state of matter is the metal ball-and-ring?
6. Did the cool metal ball pass easily through the ring?
7. What happened when the metal ball was heated?
8. What does expand mean?
9. What is the opposite of expand?
10. What is a liquid?
11. What state of matter is water?
12. What happened when the water was heated?
13. What is a gas?
14. What state of matter is air?
15. What gas was in the empty flask?
16. What happened when this gas was heated?
17. What happens when all solids are heated?
18. What happens when all liquids are heated?
19. What happens when all gases are heated?
20. What happens when all states of matter are heated?
21. What happened when the expansion bar was heated?
22. Why?

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Name: _____

Per. _____ Table _____

DENSITY: AN IMPORTANT PROPERTY OF MATTER

Read Principals of Science, Book One, pp. 64-65.

1. What is density?
2. What is necessary to measure density?
3. How can you measure mass?
4. How can you measure volume?
5. How is density expressed?
6. 1 ml = 1 _____.
7. How is density usually expressed?
8. How is density expressed in the English system?
9. Study Table 4-2 on page 65 and Fig. 4-11 on page 67. Complete the chart below.

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DENSITIES OF SOME SUBSTANCES

Substance	Density (g/cm^3) at 20^oC
Mercury	
Cork	
Aluminum	
Steel	
Lead	
Air	
Corn Syrup	
Rubber	
Glycerin	
Water	
Plastic	

Densities of Some Substances (Cont.)

10. Now, arrange the densities of these substances from least dense to most dense!

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

_____ (g/cc)

ACTIVITY: HOW TO DETERMINE DENSITIES

80

Density of Rubber

Find the mass of a #3 rubber stopper. Mass = _____ g

Find the volume displaced by the rubber stopper in a 100 ml graduated cylinder. Volume = _____ cc

Density of rubber = _____g/ _____ cc

= _____ g/cc

How do your calculations compare with the known density of rubber, which is 1.34 g/cc?

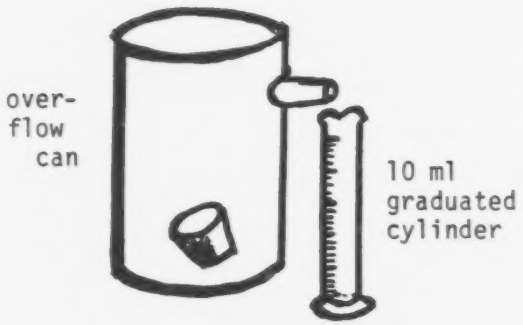
Density of a Metal

Find the mass of a metal. Mass = _____ g

Find the volume of the metal. Use the overflow can. Measure the water displaced in a 10 ml graduated cylinder. Volume = _____ cc

Density of metal = _____g/ _____cc

= _____g/cc



Activity: Turpentine and Alcohol

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Fill a bottle 1/2 full of turpentine; then slowly add alcohol to fill the bottle completely. Add a few drops of food color and close the bottle tightly.

1. What do you observe?
2. Which liquid is denser, alcohol or turpentine?
3. The density of alcohol is 0.8 g/ml. Is it more or less dense than that of water?
4. What is the density of water? _____g/ml

Shake the bottle. What happens?

Let the mixture settle for a few minutes. Hold bottle on its side, and tilt gently from side to side. What happens?

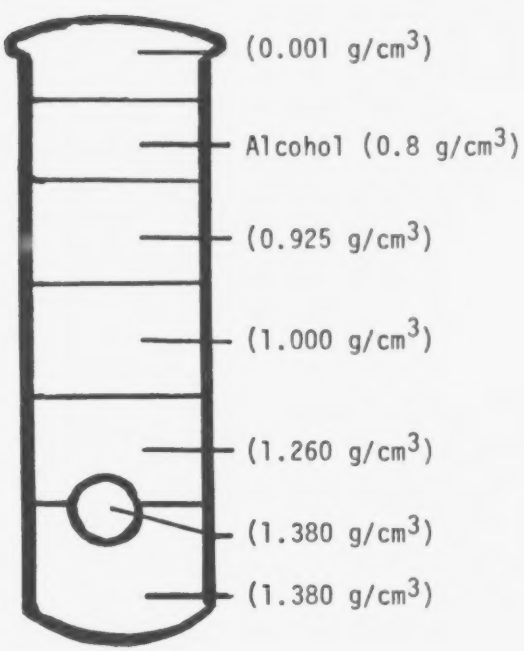
Buoyancy Is Related to Density

Read Principles of Science, Book One, pp. 65-68.

1. What is buoyancy?
2. What are some substances that float on water?
3. Why?
4. What happens when an object is placed in a liquid?
5. Why does the water level rise?
6. When will an object float?
7. Who was Archimedes?
8. What is Archimedes' Principle?

ACTIVITY: ARCHIMEDES' PRINCIPLE

(See demonstration of Archimedes' Principle in class.)



9. Why does ocean water support floating objects better than does fresh water?
10. What is the density of water?
11. What is the density of ocean water?
12. What is the density of alcohol?
13. What is the density of air (in g/l)?
14. Which gas is the least dense of all gases?
15. What is its density?
16. What is the density of the gas helium?
17. If you inflated two balloons, one with hydrogen and one with helium, which balloon would rise faster? Why?

SAMPLE LESSON III: POTENTIAL AND KINETIC ENERGY

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Students will be able to recognize the difference between potential energy and kinetic energy.

Skills Emphasized: Observing, speaking, writing, reading, listening, graphing

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to recognize the difference between potential energy and kinetic energy.

2. Value to Students

   Students become aware of how potential energy can change to kinetic energy.

3. Initial Instruction/Teacher Presentation

   With overhead projections, teacher explains the differences between potential and kinetic energy. Students respond by giving illustrations of how potential energy can change to kinetic energy.

   Illustrations can include "a drawn bow-and-arrow," "water at the top of a dam," etc.

   Teacher sets up a pendulum demonstration (a weight suspended by a string from a ring stand) and demonstrates how the weight can change from potential to kinetic energy.

   Teacher sets up materials for guided group practice.

   Materials Needed

Teacher Demonstration:	Group Practice:
ring stand	ball
string or wire	meterstick
100 g. weight	tape

4. Guided Group Practice

   Students hold a rubber ball at different heights and measure the height of their return, demonstrating the potential and kinetic energy.

   Teacher instructs students in how to show their results in a graph.

5. Independent Practice

Students are given an assignment to make a graph of the results of their guided group practice.

6. Individual Differences

Remediation/alternative activities: Students who show understanding of the independent practice aid students who do not.

Teacher reviews how potential energy changes to kinetic energy.

Enriched/supplemental activities: Teacher provides additional worksheets giving examples of potential vs. kinetic energy.

Students solve definition puzzles related to the subject matter.

Students solve word search puzzles related to the subject matter.

7. Evaluation

Discussion and review of student graphs of the guided group practice and the independent practice

Review of graphing techniques

Results of teacher-prepared quiz based on material

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SAMPLE LESSON IV: CONSTELLATIONS

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Students will demonstrate a knowledge of the relative sizes and the composition of planets, stars, the solar system, the Milky Way Galaxy, and the known universe.

Skills Emphasized: Speaking, writing, reading, listening

Thinking/Cognitive Skills: Knowledge

1. Specific Objective

   Students will be able to identify important constellations, stars, and star magnitudes.

2. Value to Students

   Students will become familiar with constellations and stars.

3. Initial Instruction/Teacher Presentation

   Teacher designs a worksheet in which the students will connect the individual stars with lines to form star patterns.

   Teacher prepares overhead transparencies or large flashcards to demonstrate how the star patterns can be recognized.

4. Guided Group Practice

   Teacher uses overhead transparencies or flashcards for student identification of constellation patterns.

5. Independent Practice

   Students are given worksheets to complete questions about constellation patterns, stars which make up the constellation, and star magnitudes.

6. Individual Differences and Learning Modalities

   Remediation/alternative activities: Filmstrips, additional reinforcement with use of flashcards, student groups helping each other, students making constellation patterns with gummed stars.

Enriched/supplemental activities: Filmstrips, "Constellation Fun" worksheet (see sample), student reports on the mythological stories of the constellations, posters of constellations, 3-D models of constellations.

7. Evaluation

Students will be able to identify important constellations in identification quizzes.

Sky Watcher: _____

Per. ____ Table ____

CONSTELLATIONS

Instructions: Look at transparencies of some familiar constellations. With a ruler, neatly connect the stars with lines to form constellation patterns.

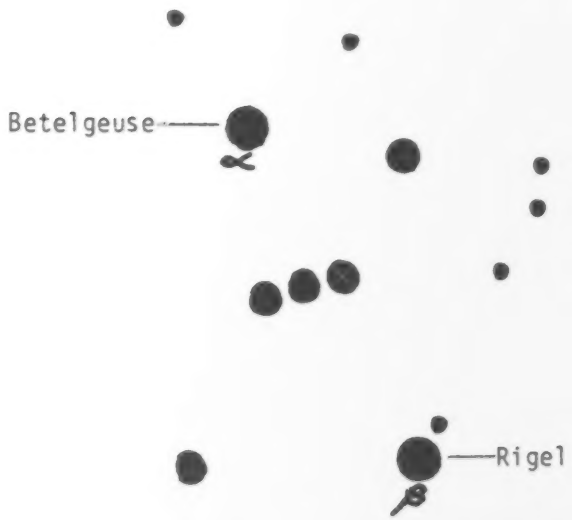
NOTE: ● = 1st magnitude stars

● = 2nd magnitude stars

● = 3rd, 4th, 5th magnitude stars

α = Alpha star

β = Beta star



Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____

Beta star: _____

Magnitude: _____

Which star is actually brighter?

_____

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Latin name: _____

English name: _____

_____

Latin name: _____

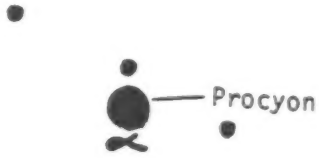
English name: _____

Alpha star: _____

Importance of Sirius: _____

_____

Magnitude: _____

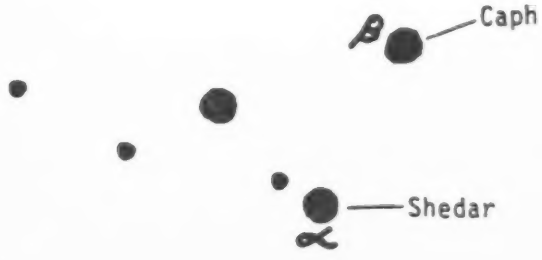


Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____



Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____

Beta star: _____

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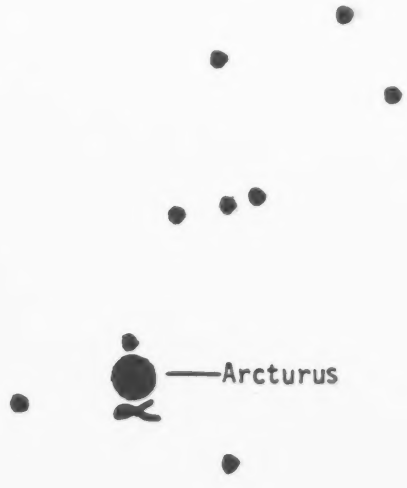


Latin name: _____

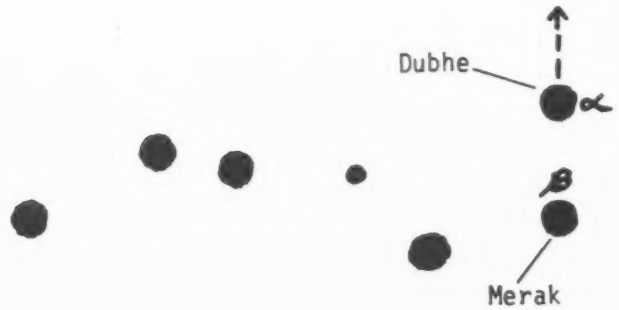
English name: _____

Alpha star: _____

Magnitude: _____

Latin name: _____

English name: _____



Latin name: _____

English names: _____

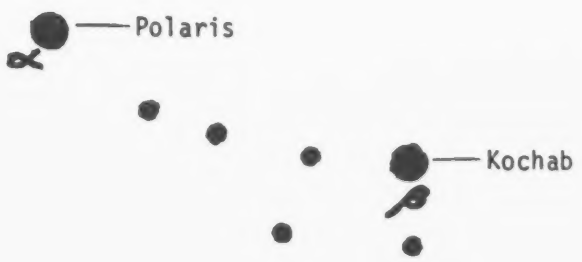
_____

Alpha star: _____

Beta star: _____

What "Pointer Stars" point to:

_____



Latin name: _____

English names: _____

_____

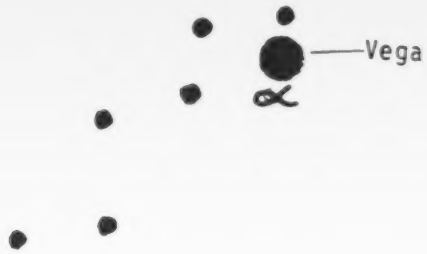
Alpha star: _____

Beta star: _____

Importance of Polaris: _____

_____

CONSTELLATIONS (CONT.)

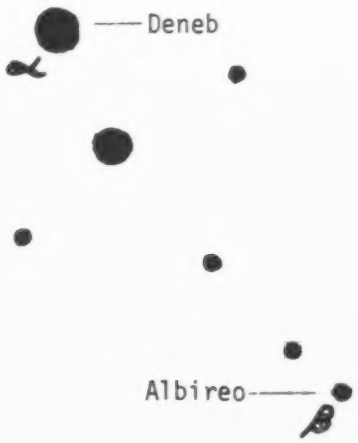


Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____



Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____

Beta star: _____

Magnitude: _____

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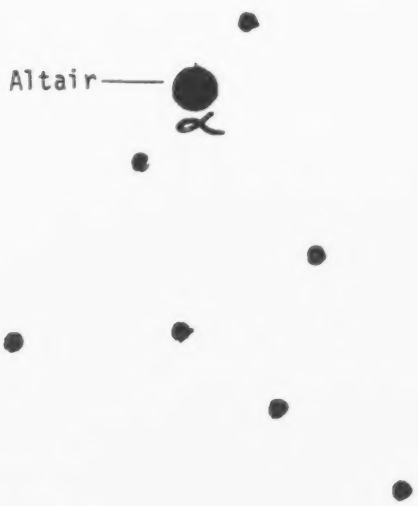

Latin name: _____

English name: _____

Alpha star: _____

Magnitude: _____

ZODIAC CONSTELLATIONS

Latin name: _____

English name: _____

_____

Zodiac dates: _____

_____

Zodiac sign:

Latin name: _____

English name: _____

Zodiac dates: _____

_____

Zodiac sign:

Latin name: _____

English name: _____

Alpha star: _____

Zodiac dates: _____

_____

Zodiac sign:

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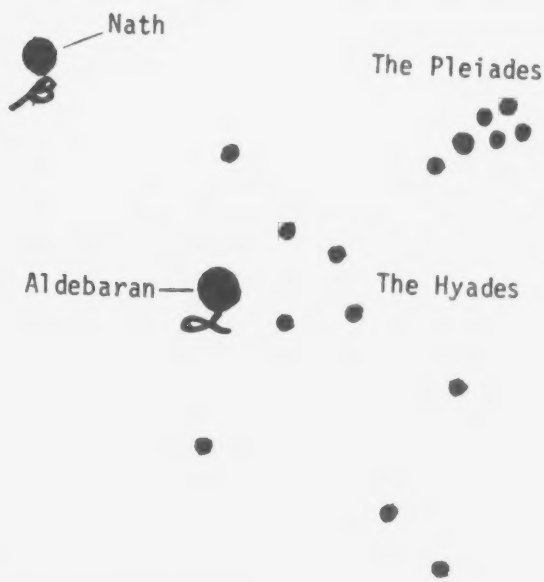
ZODIAC CONSTELLATIONS (CONT.)



Latin name: _____

English name: _____

Alpha star: _____

Beta star: _____

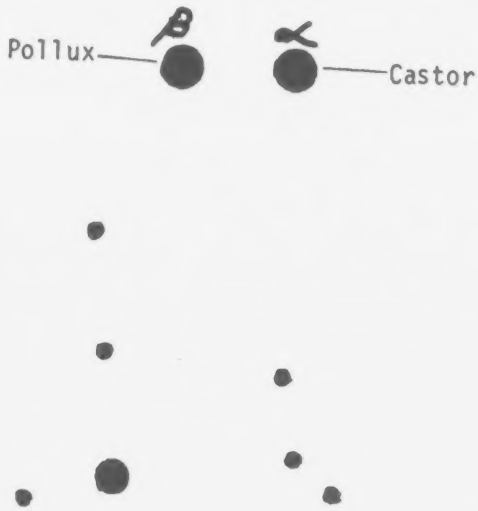
Two other constellations included in Taurus: _____

and _____

Zodiac dates: _____

_____

Zodiac sign:



Latin name: _____

English name: _____

Alpha star: _____

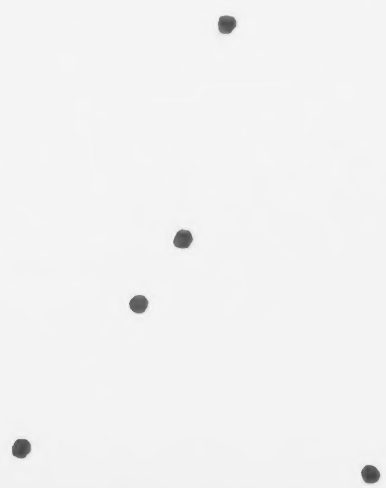
Beta star: _____

Zodiac dates: _____

_____

Zodiac sign:

92



Latin name: _____

English name: _____

Zodiac dates: _____

_____

Zodiac sign:

Latin name: _____

English name: _____

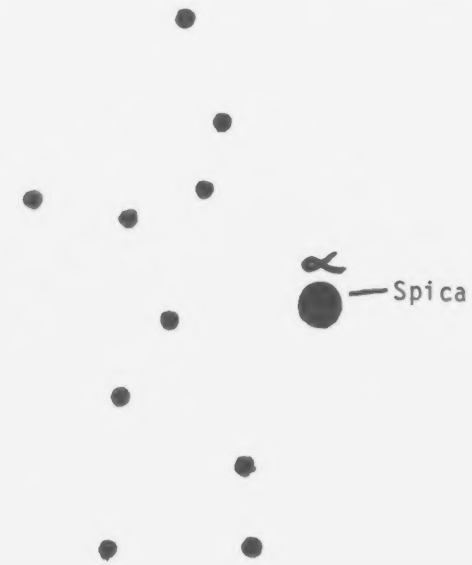
Alpha star: _____

Beta star: _____

Zodiac dates: _____

_____

Zodiac sign:



Latin name: _____

English name: _____

Alpha star: _____

Zodiac dates: _____

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_____

Zodiac sign:

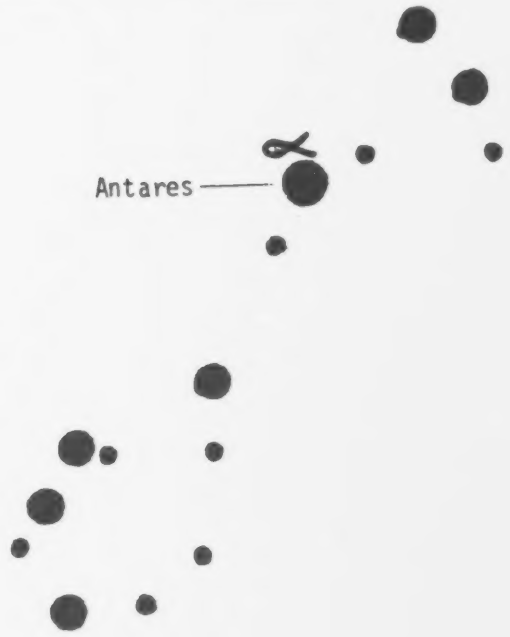
Latin name: _____

English name: _____

Zodiac dates: _____

_____

Zodiac sign:



Latin name: _____

English name: _____

Alpha star: _____

Zodiac dates: _____

_____

Zodiac sign:

Latin name: _____

English name: _____

Zodiac dates: _____

_____

Zodiac sign:

94

Latin name: _____

English name: _____

Zodiac dates: _____

_____

Zodiac sign:

Constellation Champ: _____

Per. ____ Table ____

CHAMPIONSHIP CONSTELLATION REVIEW!

Refer to your constellation charts and complete the following:

1. Constellation with a "W" shape: _ _ _ _ _ _ _ _ _ _ _ _
2. Arcturus is its brightest star: _ _ _ _ _ _ _
3. "The Flying Horse": _ _ _ _ _ _ _ _
4. Its brightest star is Procyon: _ _ _ _ _ _ _ _ _ _ _ _
5. The brightest constellation in the sky: _ _ _ _ _ _
6. Constellation which contains the brightest star in the sky:

   _ _ _ _ _ _ _ _ _ _ _ _

7. Name of the brightest star in the sky: _ _ _ _ _ _ _
8. Constellation which contains the pointer stars: _ _ _ _ _ _ _ _ _ _ _
9. Names of the two "pointer" stars: _ _ _ _ _ _ _ and _ _ _ _ _ _ _
10. Constellation which contains the North Star or Pole Star:

    _ _ _ _ _ _ _ _ _ _ _

11. Name of star pointed to by the "pointer" stars: _ _ _ _ _ _ _ _
12. Name of star also called the "North Star" or "Pole Star": _ _ _ _ _ _ _ _ _
13. Constellation which contains the bright star Vega: _ _ _ _
14. Constellation which contains the bright stars Betelgeuse and Rigel: _ _ _ _ _ _
15. Constellation which contains the stars Deneb and Albireo: _ _ _ _ _ _ _
16. Constellation which contains the star Altair: _ _ _ _ _ _ _
17. The brightest star of a constellation: _ _ _ _ _ _ star
18. The second brightest star of a constellation: _ _ _ _ _ star
19. Its brightest stars are Regulus and Denebola: _ _ _
20. Constellation which contains the bright stars Castor and Pollux: _ _ _ _ _ _ _
21. Constellation which contains the star Hamal: _ _ _ _ _ _

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CHAMPIONSHIP CONSTELLATION REVIEW (CONT.)

22. Constellation which contains two other constellations (The Pleiades and the Hyades):

    _ _ _ _ _ _ _

23. Its brightest star is Spica: _ _ _ _ _ _

24. Constellation which contains the star Antares: _ _ _ _ _ _ _ _ _

25. Constellation which contains the star Aldebaran: _ _ _ _ _ _ _

26. Stars which form a pattern or picture in the sky:

    _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

27. The brightness of a star: _ _ _ _ _ _ _ _ _ _

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LATIN AND ENGLISH NAMES OF CONSTELLATIONS

Refer to your constellation charts again and find the English or Latin names of the following constellations:

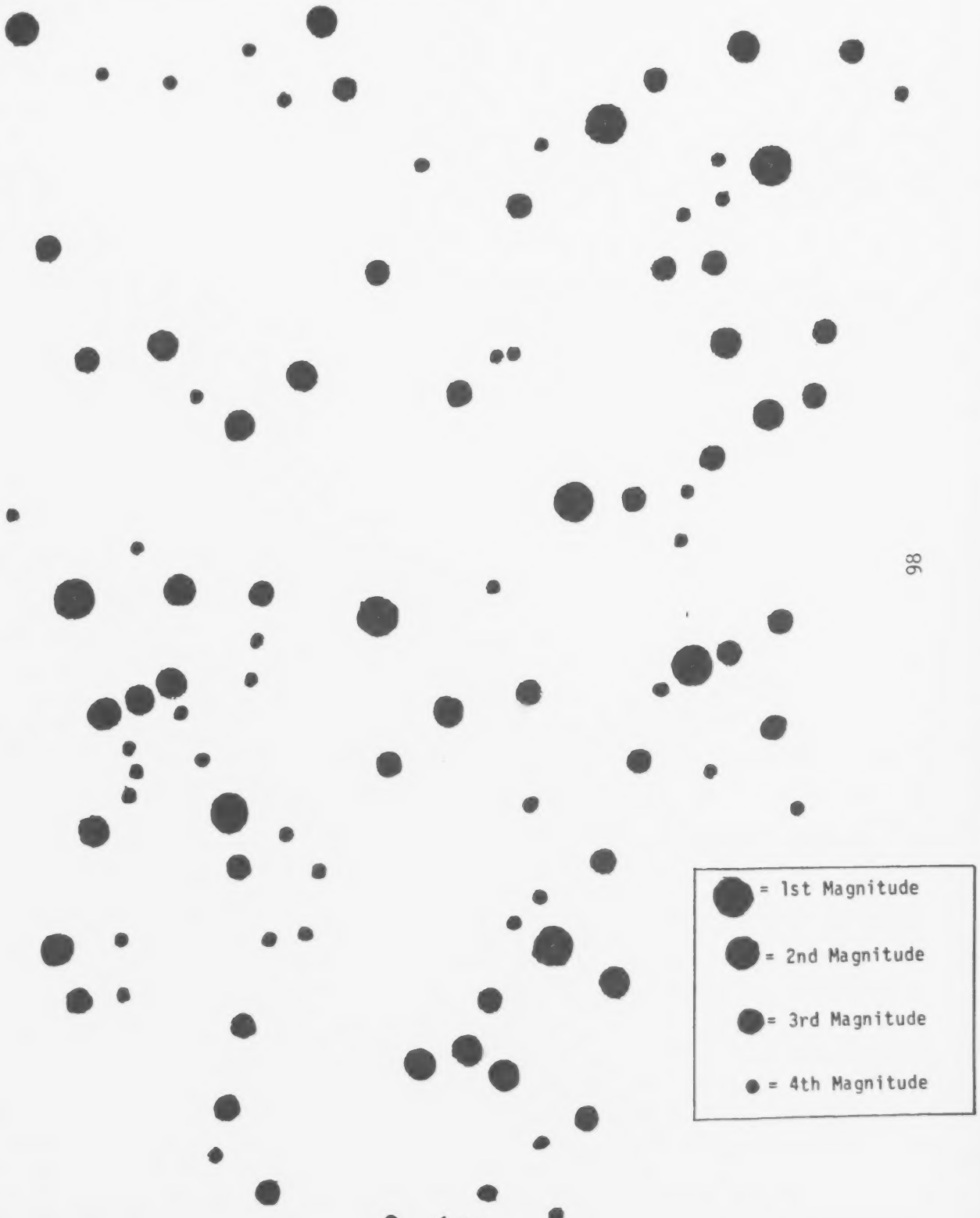
	Latin Name		English Name
1.	Taurus	1.	"_____"
2.	_____	2.	"The Scorpion"
3.	_____	3.	"The Virgin"
4.	Libra	4.	"_____"
5.	Aries	5.	"_____"
6.	_____	6.	"The Water Carrier"
7.	_____	7.	"The Twins"
8.	Cancer	8.	"_____"
9.	_____	9.	"The Lion"
10.	_____	10.	"The Archer"
11.	Capricorn	11.	"_____"
12.	_____	12.	"The Fish"
13.	_____	13.	"The Eagle"
14.	_____	14.	"The Swan"
15.	_____	15.	"The Hunter"
16.	Lyra	16.	"_____"
17.	_____	17.	"The Dragon"
18.	_____	18.	"The Little Bear"
19.	_____	19.	"The Big Bear"
20.	_____	20.	"The Big Dipper"
21.	_____	21.	"The Little Dipper"
22.	Canis Major	22.	"_____"
23.	_____	23.	"The Little Dog"
24.	Pegasus	24.	"_____"
25.	_____	25.	"The Herdsman"
26.	Cassiopeia	26.	"_____"

CONSTELLATIONS: TONIGHT'S SKY

Imagine that this page shows tonight's sky!
Connect the stars with lines to identify the constellations. Name each constellation and star.

Star-Gazer: _____

Per. _____ Table _____



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SAMPLE LESSON V: ROCK IDENTIFICATION

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Demonstrates knowledge of the processes of science.

Skills Emphasized: Writing, reading, listening, speaking

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to identify different rock types and classify them as either igneous, sedimentary or metamorphic.

2. Value to Students

   Students will be able to recognize and classify different rock samples as igneous, sedimentary, or metamorphic types of rocks.

3. Initial Instruction/Teacher Presentation

   With overhead transparencies or lecture, teacher describes the rock cycle and reviews density determinations.

   Teacher prepares boxes of rock samples.

   Teacher identifies each sample by name.

   Teacher prepares a worksheet for rock identification.

   Teacher sets up beam balances, overflow cans, and graduated cylinders for determining densities of the rock samples.

   Materials Needed

Boxes of rock samples:	Basalt	Pumice	Sandstone	Slate
	Granite	Tuff	Limestone	Marble
	Lava rock	Coquina	Coal	

4. Guided Group Practice

   Students enter observations of rock characteristics on rock identification worksheet.

Students determine densities of various rock samples.

5. Independent Practice

Students are given an assignment to list the differences between the three types of rocks.

6. Individual Differences

Remediation/alternative activities: Students who understand the rock cycle aid students who do not. Teacher conducts additional review of rock cycle and rock examples.

Enriched/supplemental activities: Students prepare graphs of the densities of various rock samples. Students make library reports and class presentations concerning a particular rock type or groups of rocks.

7. Evaluation

Results of teacher-prepared or practical laboratory quiz in which rock samples are displayed and questions pertaining to samples are asked.

SAMPLE LESSON VI: WEATHER RECORDING

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Interpret current weather conditions and relate climatic factors to the effects of the sun and our ocean.

Skills Emphasized: Speaking, writing, reading, listening

Thinking/Cognitive Skills: Application

1. Specific Objective

   Students will be able to observe and measure data for weather predictions.

2. Value to Students

   Students will use tools for recording daily weather patterns.

3. Initial Instruction/Teacher Presentation

   Teacher introduces the thermometer, barometer, and psychrometer to students and explains how they are used in recording weather changes.

   Teacher reviews air pressure, air temperature, and relative humidity.

   Teacher prepares a daily weather chart for student recordings of weather patterns.

   Materials Needed

   Celsius thermometer Aneroid barometer Psychrometer

4. Guided Group Practice

   Students measure air temperature with a thermometer, air pressure with a barometer, and relative humidity with a psychrometer. For a week, students record results daily on a chart.

5. Independent Practice

   Students will collect weather reports from newspapers and report on them in class. Students determine relative humidity from charts using data collected during guided group practice.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Students who understand how to read thermometers, barometers, and psychrometers help students who do not.

Enriched/supplemental activities: Students write reports on tornadoes, hurricanes, cloud types, the thermometer, and the barometer. Students convert Celsius to Fahrenheit temperatures.

7. Evaluation

Students are given a teacher-designed test on weather determination.

SAMPLE LESSON VII: THE OCEAN'S FLOOR

Course: Introductory Physical and Earth Science 8AB

Representative Objective: Identify the main areas of the ocean floor.

Skills Emphasized: Speaking, writing, reading, listening

Thinking/Cognitive Skills: Knowledge

1. Specific Objective

   Students will be able to recognize structural features of the ocean's floor.

2. Value to Students

   Students will be able to identify certain geologic structures that exist beneath the ocean.

3. Initial Instruction/Teacher Presentation

   Teacher introduces oceanography unit with lecture, reading assignments, or use of audiovisual materials.

   Teacher prepares a diagram of the ocean floor on which students can label various structures. Diagram should include land, shoreline, continental shelf, continental slope, continental rise, seamounts, volcanic islands, abyssal plains, deep sea trenches, mid-ocean ridges, rifts, etc.

4. Guided Group Practice

   Students label diagrams from textbooks or overhead projection.

5. Independent Practice

   Students are given a class or homework assignment to describe each ocean structure which they have labeled on their diagrams.

6. Individual Differences and Learning Modalities

   Remediation/alternative activities: Additional practice with audiovisual materials, additional reading assignments.

Enriched/supplemental activities: Students make oral or written reports on such topics as echo sounding, formation of volcanic islands, the Marianas Trench, and how humans are changing the ocean (waste dumping, oil drilling, etc.).

7. Evaluation

Students identify ocean structures on a teacher-prepared quiz.

TEACHING STRATEGIES

A variety of instructional strategies can enhance the students' growth in concept and skill development. Examples of these instructional strategies include:

- Teacher-directed lesson with the class investigating the same problem.

- Teacher demonstration with the class observing and recording observations and data.

- Independent study. Students conduct independent research and study concept or process areas. When completed, such individual work provides a basis for class learning projects.

- Team learning situations wherein two to four students function together as a laboratory investigation group. Interaction within and among groups acts both as a stimulus and an information-sharing aid to learning.

- Grouping of lower-achieving students with those achieving at a higher level. This permits peer tutoring and interaction which can benefit the less motivated individuals.

- Contract between student and teacher which outlines and prescribes specific tasks to be performed by the student for the fulfillment of certain course requirements.

- Self-paced learning designed for mastery. Assessment is conducted as each student concludes each unit, and the results indicate whether a student is ready to advance to the next unit or experience--a repeated opportunity for the instructor to use a new strategy. Student's mark is based on number of units mastered.

- Library research studies wherein many of the principles learned in laboratory and class activities can be applied to a class, small group (team), or individual project.

- Class presentations by individual or laboratory teams on the outcomes of laboratory investigations which are shared with the class.

- Design and formulation of research projects. Individuals or teams apply the methods, materials, and techniques learned to a real experimental investigation.

HIGHER LEVELS OF THINKING

Because questioning is the primary tool in achieving educational goals, teachers will want to be sure their questions are appropriate for the ability level of students and challenge students to higher levels of thinking.

Bloom[1] classifies six levels of thinking. They are:

- Knowledge (recognition or recall of previously learned material)
- Comprehension (translation or interpretation of data)
- Application (application of past learning to a new situation)
- Analysis (emphasis on the breakdown of material into constituent parts, the detection of relationships, and the organization of parts)
- Synthesis (organization of separate elements in a new creative structure)
- Evaluation (arrival of value judgments about a material or work)

The levels of thinking are sequential. In other words, each category of thinking is different and builds on lower categories. The categories are arranged from simple to complex and from concrete to abstract.

It is important that all students have many opportunities to answer questions involving every level of thinking. Within each category of thinking there are both simple and complex questions for slow and for rapid learners.

Questioning is particularly important during guided group practice in the teacher-directed lesson. Carefully constructed questions using various levels of thinking will help the teacher determine the students' comprehension of new material and assess their readiness to move on to independent practice. Individualization of instruction and remedial or alternative work can be achieved by constructing questions of varying levels of complexity.

Verbs alone do not necessarily determine the level of thinking. A given question may not represent the same task to all students. What may be an analysis question to one student may be a knowledge question to a pupil who has already read and received an explanation of the material. The level of a question depends on how much information the student has already received. If a student is expected to anwer a "why" or "how" question by restating an answer provided in the textbook or from the teacher's lecture, the level of thinking is knowledge. If, however, the student has to figure out the answer, not simply remember it, the student is working on a higher level of thinking, such as analysis, synthesis, or evaluation.

[1] Benjamin S. Bloom: Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain (Longman, New York, 1956).

Six categories of thinking and suggested verbs for teachers are provided on the following page. Teachers will find these helpful in constructing questions and planning lessons. For further classification of learning levels in the affective and psychomotor domains, teachers are referred to Reaching Higher Levels of Thought, Los Angeles Unified School District, Office of Secondary Instruction; Publication No. X-118, 1982.

MAJOR CATEGORIES AND SOME POSSIBLE VERBS FOR USE IN STATING COGNITIVE OUTCOMES

KNOWLEDGE	COMPREHENSION	APPLICATION	ANALYSIS	SYNTHESIS	EVALUATION
define	translate	interpret	dinstinguish	compose	judge
repeat	restate	apply	analyze	plan	appraise
record	discuss	employ	calculate	propose	evaluate
list	describe	use	experiment	design	rate
recall	recognize	demonstrate	test	formulate	revise
name	explain	dramatize	compare	arrange	score
relate	express	practice	contrast	assemble	assess
underline	identify	illustrate	criticize	collect	estimate
	locate	operate	diagram	construct	choose
	report	schedule	inspect	create	measure
	review	shop	debate	set up	select
	tell	sketch	inventory	organize	value
			question	manage	
			relate	prepare	
			solve		
			examine		
			categorize		

EVALUATION PROCEDURES

The evaluation of instruction is an integral part of the education process. It provides information on what has been accomplished and where to go next. The first phase of evaluation should be diagnostic. The teacher should assess what students know before instruction begins, and then plan an appropriate course based on students' knowledge and abilities. In addition to diagnostic pretesting, ongoing evaluation during instruction provides teachers with a record of student progress and indicates the instructional changes that may have to be made in order to plan for maximum achievement. Post-testing is used to assess how well students have met the objectives at the end of the unit or course. The Secondary Science Continuum provides teachers with a basis for the development of instructional objectives.

The selection or construction of appropriate instruments of evaluation is critical to the measurement process. Test items must measure and reflect instructional objectives. Tests of achievement and problem-solving skills often require advanced reading skills. Therefore, it is recommended that diagrams, graphs, and pictures also be used to evaluate student progress and achievement.

Various measures of evaluation can be used in all phases of science education. Achievement tests are used to assess science knowledge and comprehension. Problem-solving measures are useful in determining higher cognitive skills, such as analysis, synthesis, and evaluation. Motor skills and skill in the application of scientific knowledge can be evaluated in the laboratory setting. Observations and interview techniques are useful in the assessment of such laboratory skills as manipulation of materials, setting up experiments, handling and caring for live specimens, and employing safety practices. These measurement techniques allow for immediate feedback to students.

Suggested assessment procedures include the following: teacher-prepared tests; commercially prepared tests; departmental tests; informal and formal assessment of individual and group activities in oral work and discussion; and student-prepared test items, which provide reinforcement and the opportunity to apply course content.

TIPS FOR PARENTS

There are many ways in which parents can provide the proper guidance, motivation, assistance, and a nurturing home environment that will contribute to their youngster's success and learning in science.

1. Show an active interest in your youngster's science learning activities. Take notice of and respond to science-related conversations, books, and magazine and newspaper articles.

2. Be an observer. Offer assistance with a statement like, "We can discover by observation." This will stimulate and help your youngster to understand how knowledge develops through observation, thought, explorations, and verification.

3. Be a good listener, and discuss science interests and questions. This will help you learn more about your youngster's interests, thinking and reasoning abilities, and attitudes.

4. Read, review, and discuss homework and other class assignments.

5. Share experiences. For example, if you are an amateur gardener, a mechanically inclined person, or a rock and mineral collector, you have something to share and to contribute to your youngster's developing curiosity about scientific interests.

6. Learn together. Encourage questions. Help your youngster locate sources of information and plan activities that provide opportunities for observing, experimenting, and recording data and the results of experimentation.

7. Practice scientific skills and attitudes. For examples, help your youngster learn to withhold judgments until sufficient evidence has been secured, to challenge sources of information, and to be open-minded. These efforts will lead students toward the attainment of productive scientific attitudes.

8. Provide a quiet work and study area which can be used for preparing homework, studying, developing collections, experimenting, and making things.

9. Provide materials for learning, such as science-related books and magazines. Not only do they help students answer questions, but they also provide opportunities to experience the satisfaction of independent discovery.

10. Plan visits to museums, science fairs, observatories, zoos, national parks, open houses at universities, industry and governmental agencies, and other places of scientific interest.

11. Discuss with the teacher your youngster's progress and the specific learning needs which can be met through home study and how your youngster might receive individualized help if needed.

12. Consult with the teacher and librarian about the selection of science-related books, magazines, and other materials available for reading. Become familiar with some of the science apparatus, displays, books, audiovisual materials, and other instructional resources used by the school.

13. Learn about the school's science program. Parental support of the school program is an essential factor in shaping positive attitudes toward education.

APPENDICES

APPENDIX A: RESOURCES

A Collection of Selected Goals and Objectives: Los Angeles Unified School District: Office of Instruction.

A Statement of Goals. Los Angeles Unified School District: Office of Instruction. Publication No. GC-31, 1975.

Administrative Directives and Curricular Information. Los Angeles Unified School District: Office of Instruction. Publication No. SC-769. Stock No. 461260. 1984.

Audiovisual Materials Resource List, Secondary Schools Edition. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Blue Print for Bulletin Boards. Los Angeles Unified School District: Office of Secondary Instruction. Publication No. SC-824, 1983.

Catalog of Films for Secondary and Adult Levels. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Catalog of Standard Equipment for Elementary, Secondary, and Adult Schools. Latest Revision. Los Angeles Unified School District: Purchasing Branch

Catalog of Standard Supplies for Elementary, Secondary, and Adult Schools. Latest Revision. Los Angeles Unified School District: Purchasing Branch

Conservation of Energy, Suggested Activities for Pupils. Los Angeles Unified School District: Instructional Planning Division. Publication No. EC-448. Available from regional science centers.

Evaluation Summary - Science Continuum Assessment, Version 1, 1979-1980; Version 2, 1981. Los Angeles Unified School District: Office of Instruction.

Guidelines for Assignment of Homework for Elementary and Secondary Schools. Los Angeles Unified School District: Office of Instruction. Publication No. GC-67, 1978. 16 pp.

Guidelines for Instruction, Science, Secondary School Curriculum. Los Angeles Unified School District: Office of Instruction. Publication No. SC-769.19, 1934. Stock No. 461278.

Instructions for Teachers on the Assessment of the Secondary Science Continuum, Grades 7-12, for Junior and Senior High Schools, 1980-81. Los Angeles Unified School District: Office of Instruction. Publication No. SC-795, 1980.

List of Authorized Textbooks, Junior and Senior High Schools and Community Adult Schools. Latest Revision. Los Angeles Unified School District: Textbook Services Section. Publication No. 426.

List of California State Series Textbooks and Prepared Instructional Materials. Latest Revision. Los Angeles Unified School District: Textbook Services Section.

Marking Practices and Procedures for Elementary and Secondary Schools. An Instructional Bulletin. Los Angeles Unified School District: Office of Instruction. Publication No. GC-74, 1978. 62 pp.

Metrics (SI) for the Secondary Classroom. Los Angeles Unified School District: Office of Instruction. Publication No. SC-731, 1976. 186 pp.

Ordering Secondary Science Continuum Assessment Instruments and Support Materials. Los Angeles Unified School District: Office of Instruction. Latest Revision.

Parents and Schools: A Shared Responsibility. Los Angeles Unified School District: Office of Instruction. Publication No. GC-96, 1983.

Putting Critical Thinking to Work. Los Angeles Unified School District: Office of Instruction. Publication No. EC-501. Stock No. 463180.

Reaching Higher Levels of Thought. Los Angeles Unified School District: Office of Instruction. Publication No. X-118. Stock No. 463320.

Safety and Workers Compensation Reference Guide. Los Angeles Unified School District, 1980. Sections 2370-45 through 2370-54.

Science Materials Center Catalog and Loan Equipment List for Senior High Schools, Order Forms, and Other Information. Annually Revised. Los Angeles Unified School District: Office of Instruction.

Study Center Activity Cards. Los Angeles Unified School District: Office of Instruction. Publication No. GC-32. Stock No. 463640.

Suggested Terminal Objectives: Science, Junior and Senior High School. Examples of instructional objectives, together with samples of pre- and post-test items. 76 pp. Los Angeles Unified School District: Office of Instruction. Publication No. SC-711.

Teaching the Essential Skills. Los Angeles Unified School District: Office of Instruction. Publication No. GC-82. Stock No. 463818.

Test-Taking Procedures and Techniques for Secondary Schools. Los Angeles Unified School District: Office of Instruction. Publication No. X-116. Stock No. 463897.

The Teaching of Values. Los Angeles Unified School District: Office of Instruction. Publication No. GC-56. Stock No. 463810.

Use Metric! Activities to Help Parents Get the "Feel" of SI Metric Units of Measure. A Teacher's Guide. Los Angeles Unified School District: Office of Instruction. Revision. Publication No. SC726, 1979. 48 pp.

We Tried It. We Liked it. Los Angeles Unified School District: Office of Instruction. Publication No. GC-77. Stock No. 464415.

APPENDIX B: SECONDARY SCIENCE CONTINUUM

INTRODUCTION TO THE SCIENCE CONTINUUM, GRADES 7-12

PURPOSES

Science is the discipline which involves the acquiring and organizing of knowledge to explain natural phenomena and to increase their usefulness to humankind. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge comprised of interconnected sets of principles, laws, and theories that explain the known universe and our relationship to it. Students use learning processes to systematically investigate phenomena and acquire and refine information. Outcomes include understanding how human beings use scientific information and discoveries to comprehend and practice the pursuit of objective knowledge as a source of truth.

COMPONENTS

The Science Continuum encompasses the four competency strands of attitudes, thinking processes, skills, and knowledge. Within each strand, the continuum includes objectives and the kinds of performance necessary for the student to achieve each objective. However, the continuum does not limit the scope of the science curriculum. Teachers should encourage students to progress to the extent of their interests and abilities. In the continuum, certain symbols are used. Items with a solid dot identify the expectancy level for all students. Those items without dots identify levels above those expected for all students. An open circle in the K-6 column indicates that certain items are first introduced to the student in elementary school.

Attitudes Strand. This strand emphasizes the development of values, aspirations, and attitudes which promote the personal involvement of the individual with the environment and society. The attitudes listed relate to what is hoped students will accomplish, individually, through self-motivation, as a result of science instruction. Positive attitudes toward science and learning are prerequisites to effective learning in other strands.

Objectives of the attitudes strand include the ability of the learner to: internalize scientific attitudes; establish the personal and social relevance of what has been learned about science, scientists, and society; and enjoy and appreciate science.

Thinking Processes Strand. The goal is to help the student develop and apply rational and creative thinking processes. As defined here, these processes refer to the cognitive techniques involved in scientific inquiry as well as those basic to all rational thinking. Such processes as observing, measuring, comparing, and classifying lead to more sophisticated processes, such as inferring, generalizing, and theorizing.

Skills Strand. The goal is to help the student develop and use fundamental skills in the manipulation of materials and equipment, in caring for and handling living organisms, and in gathering, organizing, and communicating information relating to science. Various skills are utilized when the student employs thinking processes to develop a conceptual understanding of the natural environment and collects information through observation, manipulation of materials and apparatus, reading, listening, use of measuring instruments, and handling of living organisms. He or she employs linguistic, mathematical, graphical, and tabular skills in recording and organizing information.

A major goal of science education is the provision of opportunities for learners to develop and use these manipulative and communicative skills. Many areas of the curriculum relate closely to the skills that are critical to science education. Reading, writing, speaking, and listening skills are all basic to the communication needs of science students. Many of the skills described in the section are essential in a broad spectrum of occupations. For example, people in almost every occupation must be able to obtain, record, process, interpret, and report information and to communicate ideas in a clear, convincing manner. The skills goal is not only critical to science education, but it is also important in the development of competencies necessary for effective citizenship.

Knowledge Strand. The goal is to assist the student in developing knowledge of processes, facts, principles, generalizations, and applications -- the products of science -- and to encourage their use in the interpretation of the natural environment. Acquisition of organized knowledge is a long-range goal of science and science education. Through an understanding of contributing facts, unifying principles, and relevant processes, organized knowledge gradually takes on meaning for the learner. He or she will acquire some knowledge as a by-product of instruction intended to develop attitudes, skills, and thinking processes and will acquire other knowledge as a deliberate result of instruction. At all levels, the knowledge goal must be in balance with and consistent with the other goals of science education.

Four types of knowledge can be highlighted as components of this goal: (1) knowledge that enables the learner to communicate the thinking processes and skills of science; (2) knowledge that constitutes broad generalizations which interrelate the many facts, concepts, and principles of all the sciences; (3) knowledge of how science and technology affect society; and (4) knowledge that constitutes the content, basic concepts, and structure of the major disciplines in science.

IMPLEMENTATION

Through the in-service process, the teacher should become fully cognizant of the Science Continuum, its rationale, and its possible use. The goals and objectives of the continuum are basic to all science courses and are consistent with the provisions of AB 65 and the forthcoming State Science Framework. District-developed pretests and posttests are planned to assist teachers in evaluating each student's level of achievement in relation to the Science Continuum. The results of pretests should be used in planning instruction to meet more effectively group and individual needs. In addition, the teacher should formulate a variety of ways to assist the student needing additional instruction.

Approaches to instruction may include:

Development of learning centers
Assignment to independent study projects
Improvement of classroom management

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Use of additional instructional resources
Introduction of changes in organization within the science department;
e.g., use of minicourses, team teaching
Expansion of tutoring program
Improvement of counseling

Pretests and other tests prepared by the teacher should:

Be used to evaluate continuum goals and learner performance objectives.
Consist only of items based on performance objectives expected of all students.
Assess understanding of science concepts rather than reading ability.
Avoid items which are of a controversial nature with respect to individual religious or political beliefs.
Relate to life situations common to individuals in all cultural groups.
Involve problem statements with supporting data, as expressed in graphs, tables, pictorials, and other illustrations.
Wherever possible, relate items from skills, thinking processes, and attitudes objectives to knowledge objectives.

Test items related to attitudes should give the learner an opportunity to utilize knowledge applicable to the appropriate scientific attitude. This may or may not reflect the learner's personal attitude.

Test items related to thinking processes should be based on hypothetical problem-solving experiments and include questions that assess the student's understanding of scientific methods.

Test items related to skills should include questions about science apparatus, rules of safety, materials, and equipment common to both biological and physical sciences. Illustrations should be included.

SCIENCE CONTINUUM
GRADES 7-12

SYMBOLS
- – – – = Awareness/Exposure
- 0 = Introduction/Development
- 8 = Assessment/Evaluation
- ——— = Maintenance/Reinforcement

1.0.0 ATTITUDES

		K-6	7	8	9	10	11	12
1.1.0	SHOWS CURIOSITY ABOUT OBJECTS AND EVENTS.							
1.1.1	Shows willingness to examine and organize objects and events in the environment.	0	—	•	—	•		
1.2.0	RECOGNIZES AND REPORTS EVIDENCE OF ORDER AND SYMMETRY IN THE ENVIRONMENT.							
1.2.1	Relates classification to everyday life situations.	0	—	•	—	•		
1.3.0	APPRECIATES AND RESPECTS ALL LIVING ORGANISMS, INCLUDING SELF AND HIS/HER RELATIONSHIP TO THE ENVIRONMENT.							
1.3.1	Accepts responsibility for the care of living organisms in natural and artificial environments.	0	—	•	—	•		
1.3.2	Appreciates the interdependence of living organisms in the natural environment and the implications for continued survival.	0	—	•	—	•		
1.4.0	TAKES AN ACTIVE ROLE IN SOLVING SOCIAL PROBLEMS RELATED TO SCIENCE AND TECHNOLOGY							
1.4.1	Practices conservation in use of food, energy, and materials.	0	—	•	—	•		
1.4.2	Develops and expresses an opinion on a social issue.	0	—	—	—	—		
1.4.3	Seeks to influence the views and behaviors of others with respect to social issues related to science and technology.					—		
1.5.0	WEIGHS ALTERNATIVE SCIENTIFIC, ECONOMIC, PSYCHOLOGICAL, OR SOCIAL FACTORS WHEN CONSIDERING POSSIBLE SOLUTIONS TO SOME PROBLEMS.							
1.5.1	Recognizes the alternative factors to be considered when examining possible solutions.	0	—	•	—	•		
1.5.2	Examines a variety of alternative viewpoints on scientific issues to form opinions about them.			—	—	—		

ATTITUDES (CONT.)

		K-6	7	8	9	10	11	12
1.6.0	ORGANIZES AND REPORTS THE RESULTS OF SCIENTIFIC INVESTIGATIONS IN AN HONEST AND OBJECTIVE MANNER.							
1.6.1	Understands the need to log only those data he/she has actually gathered.	O		●		●		
1.6.2	Forms opinions only after seeking a variety of data and ideas.			●		●		
1.6.3	Assumes responsibility for reporting results in an honest and objective manner.	O		●		●		
1.7.0	HAS A CRITICAL, QUESTIONING ATTITUDE TOWARD INFERENCES, HYPOTHESES, AND THEORIES.							
1.7.1	Shows an interest in responding to contradictions between data and theory.							
1.8.0	APPLIES RATIONAL AND CREATIVE THINKING PROCESSES WHEN TRYING TO FIND RELATIONSHIPS AMONG SEEMINGLY UNRELATED PHENOMENA AND WHEN SEEKING SOLUTIONS TO PROBLEMS.							
1.8.1	Attempts spontaneously to describe an object or event that has attracted his/her attention.	O		●		●		
1.8.2	Applies science problem-solving techniques in everyday life situations.	O		●		●		
1.9.0	RECOGNIZES THE VALUES OF SCIENCE AS A HUMAN ENDEAVOR REPRESENTING ALL RACIAL, ETHNIC, AND CULTURAL BACKGROUNDS.							
1.9.1	Chooses to gather information and report on the contributions of all cultures to the scientific world.	O		●		●		
1.9.2	Acknowledges that race, sex, or nationality should not constitute a barrier to scientific study.	O		●		●		
1.9.3	Values the scientific contributions of human beings from varying cultural backgrounds.	O		●		●		

ATTITUDES (CONT.)

		K-6	7	8	9	10	11	12
1.10.0	CONSIDERS SCIENCE RELATED CAREERS AND MAKES REALISTIC DECISIONS ABOUT PREPARING FOR SUCH CAREERS, TAKING INTO ACCOUNT ABILITIES, INTERESTS, AND PREPARATION REQUIRED.							
1.10.1	Values the abilities, interests, and preparation required for a science-related career.			●		●		
1.10.2	Assumes responsibility for making a realistic decision about the pursuit of a science-related career.							

2.0.0 THINKING PROCESSES

		K-6	7	8	9	10	11	12
2.1.0	DEVELOPS ABILITY TO GENERATE DATA BY OBSERVING, RECALLING, RECOGNIZING, IDENTIFYING, AND MEASURING.							
2.1.1	Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data.	O		●		●		
2.1.2	Determines the need to repeat observations as a means of improving reliability.	O		●		●		
2.1.3	Uses measurement procedures to improve accuracy of observations.	O		●		●		
2.1.4	Identifies changes in properties and rates of change.	O						
2.2.0	DEVELOPS ABILITY TO ORGANIZE DATA BY COMPARING, CLASSIFYING, RELATING, AND ORDERING.							
2.2.1	Perceives similarities and differences in a set of objects; separates a set into groups according to a single characteristic.	O		●		●		
2.2.2	Develops arbitrary classification systems wherein objects can be put into mutually exclusive categories; uses quantitative measurements as criteria for grouping.							

THINKING PROCESSES (CONT.)

		K-6	7	8	9	10	11	12
2.3.0	DEVELOPS ABILITY TO APPLY AND EVALUATE DATA AND GENERATE THEORIES BY HYPOTHESIZING, PREDICTING, INFERRING, GENERALIZING, THEORIZING, EXPLAINING, JUSTIFYING, JUDGING, AND INTERPRETING.							
2.3.1	Examines environmental issues, pointing out contradictions and discrepancies in the positions of various groups.							
2.3.2	Gathers own data to form own point of view, satisfying any former contradictions.	0						
2.3.3	Recognizes contradictions and unusual events.							
2.3.4	Designs experiments to produce specific data to support or refute a hypothesis.							
2.4.0	PARTICIPATES IN SCIENTIFIC INQUIRY AT THE APPROPRIATE LEVEL.							
2.4.1	Defines a problem related to an unusual event.							
2.4.2	Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data.							

3.0.0 SKILLS

		K-6	7	8	9	10	11	12
3.1.0	ASSEMBLES AND USES LABORATORY APPARATUS, TOOLS, AND MATERIALS IN A SKILLFUL MANNER, GIVING DUE ATTENTION TO SAFETY MEASURES.							
3.1.1	Manipulates simple materials, apparatus, and equipment in a safe manner.	0		•		•		
3.1.2	Demonstrates growth in the ability to manipulate more complex science materials and equipment.			0		•		
3.1.3	Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.							

SKILLS (CONT.)

		K-6	7	8	9	10	11	12
3.2.0	DEMONSTRATES PROPER TECHNIQUES FOR HANDLING AND CARING FOR LIVING ORGANISMS.							
3.2.1	Handles plants and animals carefully, following suggested procedures.	0		•		•		
3.2.2	Provides an environment for plant and animal life that is conducive to the support of normal life functions.	0		•		•		
3.3.0	GATHERS THE INFORMATION NEEDED FOR DEVELOPING OR TESTING INFERENCES AND HYPOTHESES BY MAKING PURPOSEFUL, OBJECTIVE OBSERVATIONS OF THINGS AND EVENTS.							
3.3.1	Makes purposeful, objective observations.	0		•		•		
3.3.2	Determines the timing of a series of events.							
3.4.0	GATHERS NEEDED INFORMATION, WHICH HAS BEEN GENERATED BY OTHERS, FROM A VARIETY OF SOURCES APPROPRIATE TO HIS/HER ABILITY LEVEL.							
3.4.1	Listens to the ideas of others.	0		•		•		
3.4.2	Gathers information from science textbooks, reference materials, science films, and television.	0		•		•		
3.4.3	Finds sources of information needed to solve a problem related to a specific topic.	0		•		•		
3.5.0	RECORDS OBSERVATIONS ACCURATELY AND ORGANIZES DATA AND IDEAS IN WAYS THAT IMPROVE THEIR USEFULNESS.							
3.5.1	Orally describes a series of events that have taken place.	0		•		•		
3.5.2	Tabulates information and uses tables.							
3.5.3	Interprets graphs and displays data graphically.	0						
3.6.0	COMMUNICATES WITH OTHERS IN A MANNER THAT IS CONSISTENT WITH KNOWLEDGE.							
3.6.1	In group settings, orally describes observations and answers questions.	0		•		•		
3.6.2	Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.	0						

SKILLS (CONT.)

		K-6	7	8	9	10	11	12
3.7.0	USES THE METRIC SYSTEM EFFECTIVELY.							
3.7.1	Counts, uses numbers, and balances objects on an equal-arm balance scale.	○		●		●		
3.7.2	Measures linear distances, using a metric ruler.	○		●		●		
3.7.3	Uses a balance to determine the mass of objects.	○				●		
3.7.4	Measures volume of liquids in a graduated cylinder marked in metric units.							
3.8.0	APPLIES APPROPRIATE MATHEMATICAL CONCEPTS AND SKILLS IN INTERPRETING DATA AND IN SOLVING PROBLEMS.							
3.8.1	Calculates rates from data.							
3.8.2	Finds the mean and median of a series of measurements.							
3.8.3	Utilizes exponential notation to express very large and very small numbers.							
3.8.4	Determines degree of precision of measurement and quantities derived from measurements.							
3.8.5	Uses calculators and/computers to advantage in manipulating data and solving problems.							

4.0.0 KNOWLEDGE

		K-6	7	8	9	10	11	12
4.1.0	DEMONSTRATES KNOWLEDGE OF THE PROCESSES OF SCIENTIFIC INQUIRY.							
4.1.1	Distinguishes between trial and error and controlled investigations.	○		●		●		
4.1.2	Matches names of various processes and products of scientific inquiry with examples.							
4.1.3	Evaluates procedures in the inquiry process that have been omitted or inadequately performed.							

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.2.0	DEMONSTRATES UNDERSTANDING OF BASIC GENERALIZATIONS, RELATIONSHIPS, AND PRINCIPLES.							
4.2.1	Identifies simple cause-effect relationships.	○		●		●		
4.2.2	Uses a cause-effect relationship to make a prediction.	○						
4.2.3	Recognizes that atoms are composed of electrons, protons, neutrons, and other particles.	○				●		
4.2.4	Recognizes that electrons are negatively charged and protons are positively charged.					●		
4.2.5	Illustrates that the number of atomic particles varies with each element.					●		
4.2.6	Recognizes that matter is composed of particles which are in constant motion.					●		
4.2.7	Describes interaction and reorganization of units of matter and their association with changes of energy.							
4.2.8	Recognizes the uses of fuels.	○		●		●		
4.2.9	Identifies examples of kinetic and potential energy.					●		
4.2.10	Identifies pairs of objects having similar properties.	○		●		●		
4.2.11	Describes systems of classification used to sort a group of miscellaneous objects.	○		●		●		
4.2.12	Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature.			●		●		
4.3.0	DEMONSTRATES KNOWLEDGE OF RELATIONSHIPS BETWEEN SCIENCE AND SOCIETY.							
4.3.1	Gives examples of ways in which the use of scientific knowledge has affected society.	○		●		●		
4.3.2	Describes aspects of a society that tend to encourage or inhibit the advancement of science.							
4.3.3	Identifies types of data valuable in planning environmental changes.							

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.4.0	DEMONSTRATES KNOWLEDGE OF SCIENCE-RELATED CAREER OPPORTUNITIES AND THE PREPARATION NEEDED.							
4.4.1	Compares the work performed by persons in science occupations.	○	—	—	—	—	—	—
4.4.2	Identifies ways in which careers are science related.	○	—	—	—	—	—	—
4.5.0	DEMONSTRATES KNOWLEDGE OF CONTRIBUTIONS TO SCIENCE AND TECHNOLOGY MADE BY MEN AND WOMEN OF VARIOUS RACES AND NATIONALITIES.							
4.5.1	Matches significant discoveries to persons responsible.	○	—	—	—	—	—	—
4.6.0	DEMONSTRATES KNOWLEDGE OF THE RELATIONSHIPS OF SCIENCE TO OTHER AREAS OF HUMAN ENDEAVOR.							
4.6.1	Identifies how modern techniques of determining the age of specimens contribute to knowledge of earlier civilizations.			—	—	—	—	—
4.7.0	DEMONSTRATES KNOWLEDGE OF WAYS IN WHICH ATTITUDES, THINKING PROCESSES, AND SKILLS CAN BE RELATED FOR USE IN PERSONAL DECISION-MAKING.							
4.7.1	Given a list of foods, identifies items that would constitute a nutritious, balanced meal.	○	—	●	—	●	—	—
4.7.2	Given manufacturers' literature and consumer research data, selects an object on the basis of comparison of various factors.			—	—	●	—	—
4.7.3	Uses data from scientific investigations in presenting a position on a political issue.			—	—	—	—	—
4.8.0	DEMONSTRATES GENERAL KNOWLEDGE OF SCIENCE.							
4.8.1	Recognizes that a cell is the basic unit of structure and function of a living organism.	○	—	●	—	●	—	—
4.8.2	Recognizes that all living organisms have the same life processes.	○	—	●	—	●	—	—
4.8.3	Demonstrates a basic knowledge of the structures and functions of the human organism.	○	—	●	—	●	—	—
4.8.4	Understands and describes living organisms that grow and develop in different environments.	○	—	●	—	●	—	—
4.8.5	Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms.	○	—	●	—	●	—	—

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.8.6	Recognizes the importance of energy levels as related to ecosystems.			—	—	—	—	—
4.8.7	Recognizes that living organisms utilize matter and return it to the environment.	○	—	—	—	—	—	—
4.8.8	Describes examples of humankind's dependence on and interference with natural ecosystems.	○	—	●	—	●	—	—
4.8.9	Recognizes that a living organism is a product of its heredity and environment.	○	—	●	—	●	—	—
4.8.10	Recognizes that all forms of life are composed of the same elements in different DNA blueprints.			—	—	—	—	—
4.8.11	Understands relationships of structure and function of living organisms to their environment.			—	—	●	—	—
4.8.12	Recognizes that living organisms have changed over the ages and that some species are now extinct.	○	—	●	—	●	—	—
4.8.13	Recognizes that the motion and path of celestial bodies are predictable.	○	—	●	—	●	—	—
4.8.14	Describes the regular movements of the earth and moon.	○	—	●	—	●	—	—
4.8.15	Demonstrates an appreciation and understanding of time/space relationships.	○	—	—	—	—	—	—
4.8.16	Demonstrates knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.	○	—	●	—	●	—	—
4.8.17	Cites some of the accomplishments in humankind's exploration of space.	○	—	●	—	●	—	—
4.8.18	Demonstrates knowledge of the effects of moon and sun on ocean tides.	○	—	—	—	—	—	—
4.8.19	Recognizes that matter exists as solids, liquids, and gases.	○	—	●	—	●	—	—
4.8.20	Demonstrates that in chemical or physical changes the total amount of matter remains unchanged.	○	—	●	—	●	—	—
4.8.21	Recognizes that in nuclear reactions a loss of matter is a gain in energy; the sum of matter and energy remains constant.			—	—	—	—	—

KNOWLEDGE (CONT.)

		K 6	7	8	9	10	11	12
4.8.22	Recognizes that there are continuous changes on earth.	O—	—	—●	—	—●	—	—
4.8.23	Recognizes that rocks contain one or more kinds of minerals.	O—	—	—	—	—	—	—
4.8.24	Recognizes the three major types of rocks that make up the earth.	- - -	- - -	—	—	—	—	—
4.8.25	Recognizes the value of using renewable energy sources instead of non-renewable sources.	O—	—	—●	—	—●	—	—
4.8.26	Identifies major factors that cause weather changes and patterns.	- - -	- - -	—	—	—	—	—
4.8.27	Identifies the effect of weather on the local environment.	O—	—	—●	—	—●	—	—
4.8.28	Identifies the ocean as a major influence on weather.	O—	—	—●	—	—●	—	—
4.8.29	Recognizes simple machines and their functions.	O—	—	—	—	—	—	—
4.8.30	Understands the definitions and interrelationships of force, work, and energy.			—	—	—	—	—